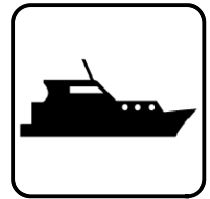


# Operation

## Marine Generator Sets



Pleasure Craft Models:

**40-150EOZDJ**  
**33-125EFOZDJ**

Commercial Models:

**40-150EOZCJ**  
**33-125EFOZCJ**

Controller:

Decision-Maker® 3500

**KOHLER®**

Power Systems

**9001**  
**KOHLER**  
POWER SYSTEMS  
NATIONALLY REGISTERED

TP-6861 10/14b



# Table of Contents

---

|   |           |
|---|-----------|
| <b>Product Identification Information</b>                         | <b>2</b>  |
| <b>Safety Precautions and Instructions</b>                        | <b>5</b>  |
| <b>Introduction</b>   | <b>9</b>  |
| <b>Service Assistance</b>   | <b>10</b> |
| <b>Maintenance and Service Parts/Related Literature</b>           | <b>11</b> |
| <b>Section 1 Specifications and Features</b>                      | <b>13</b> |
| 1.1 Introduction  | 13        |
| 1.2 Permanent Magnet Alternator Concept                           | 13        |
| 1.3 Short Circuit Performance                                     | 13        |
| 1.4 Service Views   | 15        |
| 1.5 Introduction  | 18        |
| 1.6 Controller Specifications                                     | 18        |
| 1.7 Controller Features   | 18        |
| 1.7.1 Switches and Controls                                       | 19        |
| 1.7.2 Annunciator Lamps   | 20        |
| 1.7.3 Graphical Display   | 20        |
| 1.8 Metering Menu   | 21        |
| 1.8.1 Generator Metering Submenu                                  | 21        |
| 1.8.2 Engine Metering Submenu                                     | 21        |
| 1.8.3 Overview Submenu  | 22        |
| 1.8.4 Paralleling Metering Submenu                                | 22        |
| 1.9 Generator Information Menu                                    | 22        |
| 1.9.1 Generator Information Submenu                               | 22        |
| 1.9.2 Event History Submenu                                       | 23        |
| 1.9.3 Configuration Submenu                                       | 23        |
| 1.9.4 Voltage Regulation Submenu                                  | 25        |
| 1.9.5 Voltage Selector Switch                                     | 26        |
| 1.9.6 Paralleling Operation                                       | 26        |
| 1.10 Controller Configuration Menu                                | 34        |
| 1.10.1 Controller Configuration Submenu                           | 34        |
| 1.10.2 Communication Setup Submenu                                | 34        |
| 1.10.3 Calibration Submenu  | 35        |
| 1.11 I/O Setup Menu   | 36        |
| 1.11.1 Controller Fault Diagnostics                               | 37        |
| 1.11.2 Main Logic Circuit Board                                   | 39        |
| 1.11.3 For Units Equipped with 3rd Party Marine Option            | 40        |
| <b>Section 2 Operation</b>  | <b>41</b> |
| 2.1 Prestart Checklist  | 41        |
| 2.2 Marine Inspection   | 42        |
| 2.3 Angular Limits During Operation                               | 42        |
| 2.4 Operation in European Union Member Countries                  | 42        |
| 2.5 Load Profile  | 42        |
| 2.6 Controller Operation  | 43        |
| 2.6.1 Emergency Stop  | 45        |
| 2.6.2 System Status Lamps   | 45        |
| 2.6.3 System Fault Warning Lamp with Digital Displays             | 46        |
| 2.6.4 System Fault Shutdown Lamp With Digital Displays            | 48        |
| 2.6.5 Status and Notice Digital Displays                          | 51        |
| 2.6.6 Controller Resetting (Following System Shutdown or Warning) | 52        |
| 2.7 Menu Displays   | 52        |
| 2.8 Monitoring and Programming Setup                              | 59        |
| 2.8.1 PC Communications   | 59        |

# Table of Contents, continued

---

|                   |   |            |
|-------------------|---|------------|
| 2.8.2             | Modbus® Communications .....  | 59         |
| <b>Section 3</b>  | <b>Scheduled Maintenance .....</b>                                    | <b>61</b>  |
| 3.1               | Alternator Service .....  | 61         |
| 3.2               | Engine Service .....  | 61         |
| 3.3               | Generator Set Service Schedule .....                                  | 63         |
| 3.4               | Alternator Bearing Service .....                                      | 65         |
| 3.4.1             | 20–300 kW Models .....  | 65         |
| 3.5               | Diesel Fuel Systems .....   | 65         |
| 3.5.1             | Bleeding Air from Fuel System .....                                   | 65         |
| 3.6               | Cooling System .....  | 65         |
| 3.6.1             | Cooling System Component Inspection .....                             | 66         |
| 3.6.2             | Procedure to Drain Cooling System .....                               | 66         |
| 3.6.3             | Procedure to Flush and Clean Cooling System .....                     | 66         |
| 3.6.4             | Procedure to Refill Cooling System .....                              | 66         |
| 3.6.5             | Siphon Break .....  | 67         |
| 3.6.6             | Impeller Inspection and Replacement Procedure .....                   | 67         |
| 3.7               | Exhaust System .....  | 68         |
| 3.8               | Storage Procedure .....   | 69         |
| 3.8.1             | Lubricating System .....  | 69         |
| 3.8.2             | Cooling System .....  | 69         |
| 3.8.3             | Fuel System .....   | 69         |
| 3.8.4             | Exterior .....  | 69         |
| 3.8.5             | Battery .....   | 69         |
| <b>Section 4</b>  | <b>Troubleshooting .....</b>  | <b>71</b>  |
| 4.1               | Controller Display and Voltage Regulation Troubleshooting Chart ..... | 75         |
| <b>Section 5</b>  | <b>Wiring Diagrams .....</b>  | <b>77</b>  |
| <b>Section 6</b>  | <b>Voltage Reconnection .....</b>                                     | <b>105</b> |
| 6.1               | Introduction .....  | 105        |
| <b>Section 7</b>  | <b>Accessories .....</b>  | <b>107</b> |
| 7.1               | Accessories .....   | 107        |
| 7.2               | Accessory Connections .....   | 107        |
| <b>Appendix A</b> | <b>Abbreviations .....</b>  | <b>111</b> |
| <b>Appendix B</b> | <b>Alternator Protection .....</b>                                    | <b>113</b> |
| <b>Appendix C</b> | <b>Operating Hour Service Log .....</b>                               | <b>115</b> |

# Safety Precautions and Instructions

**IMPORTANT SAFETY INSTRUCTIONS.** Electromechanical equipment, including generator sets, transfer switches, switchgear, and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained. To prevent accidents be aware of potential dangers and act safely. Read and follow all safety precautions and instructions. **SAVE THESE INSTRUCTIONS.**

This manual has several types of safety precautions and instructions: Danger, Warning, Caution, and Notice.

## **DANGER**

Danger indicates the presence of a hazard that **will cause severe personal injury, death, or substantial property damage.**

## **WARNING**

Warning indicates the presence of a hazard that **can cause severe personal injury, death, or substantial property damage.**

## **CAUTION**

Caution indicates the presence of a hazard that **will or can cause minor personal injury or property damage.**

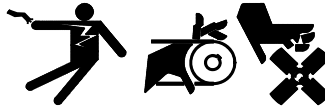
## **NOTICE**

Notice communicates installation, operation, or maintenance information that is safety related but not hazard related.

Safety decals affixed to the equipment in prominent places alert the operator or service technician to potential hazards and explain how to act safely. The decals are shown throughout this publication to improve operator recognition. Replace missing or damaged decals.

## Accidental Starting

### **WARNING**



**Accidental starting.**  
**Can cause severe injury or death.**

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

**Disabling the generator set.** **Accidental starting can cause severe injury or death.** Before working on the generator set or equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

## Engine Backfire/Flash Fire

### **WARNING**



**Fire.**  
**Can cause severe injury or death.**

Do not smoke or permit flames or sparks near fuels or the fuel system.


**Servicing the fuel system. A flash fire can cause severe injury or death.**

Do not smoke or permit flames or sparks near the fuel injection system, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuels or fuel vapors. Catch fuels in an approved container when removing the fuel line or fuel system.

**Servicing the air cleaner. A sudden backfire can cause severe injury or death.** Do not operate the generator set with the air cleaner/silencer removed.

**Combustible materials. A fire can cause severe injury or death.** Generator set engine fuels and fuel vapors are flammable and explosive. Handle these materials carefully to minimize the risk of fire or explosion. Equip the compartment or nearby area with a fully charged fire extinguisher. Select a fire extinguisher rated ABC or BC for electrical fires or as recommended by the local fire code or an authorized agency. Train all personnel on fire extinguisher operation and fire prevention procedures.

## Exhaust System

|   |
|---|
|  |
| <b>⚠ WARNING</b>  |
| <b>Carbon monoxide. Can cause severe nausea, fainting, or death.</b>              |
| The exhaust system must be leakproof and routinely inspected.                     |

**Carbon monoxide symptoms. Carbon monoxide can cause severe nausea, fainting, or death.** Carbon monoxide is a poisonous gas present in exhaust gases. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Carbon monoxide poisoning symptoms include but are not limited to the following:


- Light-headedness, dizziness
- Physical fatigue, weakness in joints and muscles
- Sleepiness, mental fatigue, inability to concentrate or speak clearly, blurred vision
- Stomachache, vomiting, nausea

If experiencing any of these symptoms and carbon monoxide poisoning is possible, seek fresh air immediately and remain active. Do not sit, lie down, or fall asleep. Alert others to the possibility of carbon monoxide poisoning. Seek medical attention if the condition of affected persons does not improve within minutes of breathing fresh air.

**Inspecting the exhaust system. Carbon monoxide can cause severe nausea, fainting, or death.** For the safety of the craft's occupants, install a carbon monoxide detector. Never operate the generator set without a functioning carbon monoxide detector. Inspect the detector before each generator set use.

**Operating the generator set. Carbon monoxide can cause severe nausea, fainting, or death.** Be especially careful if operating the generator set when moored or anchored under calm conditions because gases may accumulate. If operating the generator set dockside, moor the craft so that the exhaust discharges on the lee side (the side sheltered from the wind). Always be aware of others, making sure your exhaust is directed away from other boats and buildings.


## Fuel System

|   |
|---|
|  |
| <b>⚠ WARNING</b>  |
| <b>Explosive fuel vapors. Can cause severe injury or death.</b>                   |
| Use extreme care when handling, storing, and using fuels.                         |


**The fuel system. Explosive fuel vapors can cause severe injury or death.** Vaporized fuels are highly explosive. Use extreme care when handling and storing fuels. Store fuels in a well-ventilated area away from spark-producing equipment and out of the reach of children. Never add fuel to the tank while the engine is running because spilled fuel may ignite on contact with hot parts or from sparks. Do not smoke or permit flames or sparks to occur near sources of spilled fuel or fuel vapors. Keep the fuel lines and connections tight and in good condition. Do not replace flexible fuel lines with rigid lines. Use flexible sections to avoid fuel line breakage caused by vibration. Do not operate the generator set in the presence of fuel leaks, fuel accumulation, or sparks. Repair fuel systems before resuming generator set operation.

**Draining the fuel system. Explosive fuel vapors can cause severe injury or death.** Spilled fuel can cause an explosion. Use a container to catch fuel when draining the fuel system. Wipe up spilled fuel after draining the system.

## Hazardous Noise

|   |
|---|
|  |
| <b>⚠ CAUTION</b>  |
| <b>Hazardous noise. Can cause hearing loss.</b>                                     |
| Never operate the generator set without a muffler or with a faulty exhaust system.  |

## Hazardous Voltage/ Moving Parts

|  |
|--|
|     |
| <b>⚠ WARNING</b>   |
| <b>Hazardous voltage. Moving parts. Can cause severe injury or death.</b>              |
| Operate the generator set only when all guards and electrical enclosures are in place. |

**Servicing the generator set when it is operating. Exposed moving parts can cause severe injury or death.** Keep hands, feet, hair, clothing, and test leads away from the belts and pulleys when the generator set is running. Replace guards, screens, and covers before operating the generator set.

**Grounding electrical equipment. Hazardous voltage can cause severe injury or death.** Electrocuting is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

**Disconnecting the electrical load. Hazardous voltage can cause severe injury or death.** Disconnect the generator set from the load by turning off the line circuit breaker or by disconnecting the generator set output leads from the transfer switch and heavily taping the ends of the leads. High voltage transferred to the load during testing may cause personal injury and equipment damage. Do not use the safeguard circuit breaker in place of the line circuit breaker. The safeguard circuit breaker does not disconnect the generator set from the load.



**Short circuits. Hazardous voltage/current can cause severe injury or death.** Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.



**Engine block heater. Hazardous voltage can cause severe injury or death.** The engine block heater can cause electrical shock. Remove the engine block heater plug from the electrical outlet before working on the block heater electrical connections.

**Electrical backfeed to the utility. Hazardous backfeed voltage can cause severe injury or death.** Connect the generator set to the building/marina electrical system only through an approved device and after the building/marina main switch is turned off. Backfeed connections can cause severe injury or death to utility personnel working on power lines and/or personnel near the work area. Some states and localities prohibit unauthorized connection to the utility electrical system. Install a ship-to-shore transfer switch to prevent interconnection of the generator set power and shore power.

**Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death.** Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically. *(600 volts and under)*

## Hot Parts

|   |
|---|
|  <b>WARNING</b>  |
|    |
| <p><b>Hot coolant and steam.</b><br/><b>Can cause severe injury or death.</b></p> <p>Before removing the pressure cap, stop the generator set and allow it to cool. Then loosen the pressure cap to relieve pressure.</p> |

|   |
|---|
|  <b>WARNING</b>  |
|    |
| <p><b>Hot engine and exhaust system.</b><br/><b>Can cause severe injury or death.</b></p> <p>Do not work on the generator set until it cools.</p> |

**Servicing the exhaust system. Hot parts can cause severe injury or death.** Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.

## Notice

### NOTICE

**Fuse replacement.** Replace fuses with fuses of the same ampere rating and type (for example: 3AB or 314, ceramic). Do not substitute clear glass-type fuses for ceramic fuses. Refer to the wiring diagram when the ampere rating is unknown or questionable.

### NOTICE

**Saltwater damage.** Saltwater quickly deteriorates metals. Wipe up saltwater on and around the generator set and remove salt deposits from metal surfaces.

## Notes



This manual provides operation instructions for 40-150EOZDJ/EOZCJ and 33-125EFOZDJ/EFOZCJ John Deere- powered marine model generator sets equipped with the following controller:

- Decision-Maker® 3500

Refer to the engine operation manual for generator set engine scheduled maintenance information.

Information in this publication represents data available at the time of print. Kohler Co. reserves the right to change this publication and the products represented without notice and without any obligation or liability whatsoever.

Read this manual and carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety Precautions and Instructions section at the beginning of this manual. Keep this manual with the equipment for future reference.

The equipment service requirements are very important to safe and efficient operation. Inspect the parts often and perform required service at the prescribed intervals. Obtain service from an authorized service distributor/dealer to keep equipment in top condition.

---

**Before installing a marine generator set, obtain the most current installation manual from your local distributor/dealer. Only qualified persons should install the generator set.**

---

## Abbreviations

This publication makes use of numerous abbreviations. Typically, the word(s) are spelled out along with the abbreviation in parentheses when shown for the first time in a section. Appendix A, Abbreviations, also includes many abbreviation definitions.

## Tech Tools

**Note:** Tech Tools is for Kohler authorized personnel only.

Access Tech Tools to find the following topics:

- **Software** used by generator set controllers including updates and documentation references.
- **Network Communications** provides basics to terms, protocols, standards, wiring, configurations, and model.
- **Engine Electronic Control Module (ECM)** has information about electronic devices provided by the engine manufacturer to manage engine data.

# Service Assistance

---

For professional advice on generator set power requirements and conscientious service, please contact your nearest Kohler distributor or dealer.

- Consult the Yellow Pages under the heading Generators—Electric.
- Visit the Kohler Power Systems website at KOHLERPower.com.
- Look at the labels and stickers on your Kohler product or review the appropriate literature or documents included with the product.
- Call toll free in the US and Canada 1-800-544-2444.
- Outside the US and Canada, call the nearest regional office.

## **Headquarters Europe, Middle East, Africa (EMEA)**

Kohler Power Systems Netherlands B.V.  
Kristallaan 1  
4761 ZC Zevenbergen  
The Netherlands  
Phone: (31) 168 331630  
Fax: (31) 168 331631

## **Asia Pacific**

Power Systems Asia Pacific Regional Office  
Singapore, Republic of Singapore  
Phone: (65) 6264-6422  
Fax: (65) 6264-6455

## **China**

North China Regional Office, Beijing  
Phone: (86) 10 6518 7950  
(86) 10 6518 7951  
(86) 10 6518 7952  
Fax: (86) 10 6518 7955

East China Regional Office, Shanghai  
Phone: (86) 21 6288 0500  
Fax: (86) 21 6288 0550

## **India, Bangladesh, Sri Lanka**

India Regional Office  
Bangalore, India  
Phone: (91) 80 3366208  
(91) 80 3366231  
Fax: (91) 80 3315972

## **Japan, Korea**

North Asia Regional Office  
Tokyo, Japan  
Phone: (813) 3440-4515  
Fax: (813) 3440-2727

## **Latin America**

Latin America Regional Office  
Lakeland, Florida, USA  
Phone: (863) 619-7568  
Fax: (863) 701-7131

# Maintenance and Service Parts/Related Literature

## Maintenance and Service Parts

Figure 1-1 identifies maintenance and service parts for your generator set. Obtain a complete list of maintenance and service parts from your authorized generator distributor/dealer.

| Part Description                   | Models                |                       |                       |                       |                       |
|------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|                                    | 40EOZDJ/<br>40EOZCJ   |                       |                       | 55EOZDJ/<br>55EOZCJ   | 65EOZDJ/<br>65EOZCJ   |
|                                    | 33EFOZDJ/<br>33EFOZCJ | 40EFOZDJ/<br>40EFOZCJ | 50EFOZDJ/<br>50EFOZCJ | 45EFOZDJ/<br>45EFOZCJ | 55EFOZDJ/<br>55EFOZCJ |
| Engine                             | 4045DFM70             | 4045TFM75             |                       | 4045TFM85             |                       |
| Air Filter Element                 | 226915                | GM86446               |                       |                       |                       |
| Belt, Alternator and Seawater Pump | GM15402               |                       |                       |                       |                       |
| Fuel Filter Element, Primary       | GM48727               |                       |                       | GM48729               |                       |
| Fuel Filter Element, Secondary     | GM48728               |                       |                       | GM48730               |                       |
| Oil Filter                         | GM32809               |                       |                       |                       |                       |
| Seawater Pump Impeller Kit         | GM50644               |                       |                       |                       |                       |
| Zinc Anode                         | 352142                |                       |                       |                       |                       |

| Part Description                                       | Models                |                       |                         |                         |
|--|-----------------------|-----------------------|-------------------------|-------------------------|
|  | 80EOZDJ/<br>80EOZCJ   | 99EOZDJ/<br>99EOZCJ   | 125EOZDJ/<br>125EOZCJ   | 150EOZDJ/<br>150EOZCJ   |
|  | 70EFOZDJ/<br>70EFOZCJ | 80EFOZDJ/<br>80EFOZCJ | 100EFOZDJ/<br>100EFOZCJ | 125EFOZDJ/<br>125EFOZCJ |
| Engine   | 4045AFM85             |                       | 6068AFM85               |                         |
| Air Filter Element                                     | GM87479               |                       | GM90310                 |                         |
| Belt, Alternator and Seawater Pump                     | GM88686               |                       | GM88686                 |                         |
| Fuel Filter Element, Primary (Standard)                | GM48729               |                       | GM50263 *               |                         |
| Fuel Filter Element, Secondary (Standard)              | GM48730               |                       |                         |                         |
| Fuel Filter Element, Primary (with 3rd Party Option)   | GM50263 *             |                       |                         |                         |
| Fuel Filter Element, Secondary (with 3rd Party Option) |                       |                       |                         |                         |
| Oil Filter   | GM32809               |                       | GM32809                 |                         |
| Seawater Pump Impeller Kit                             | GM18793               |                       | GM18793                 |                         |
| Zinc Anode   | 352142                |                       | 352142                  |                         |

\* Includes primary and secondary fuel filter element

**Figure 1-1** Maintenance and Service Parts

## Related Literature

Figure 1-2 identifies related literature available for the generator sets covered in this manual. Only trained and qualified personnel should install or service the generator set.

| Literature Type  | Pleasure Craft Models |         |        |          |          |
|--|-----------------------|---------|--------|----------|----------|
|  | 40EOZDJ               |         |        | 55EOZDJ  | 65EOZDJ  |
|  | 33EFOZDJ              |         |        | 40EFOZDJ | 50EFOZDJ |
|  | Commercial Models     |         |        |          |          |
|  | 40EOZCJ               |         |        | 55EOZCJ  | 65EOZCJ  |
|  | 33EFOZCJ              |         |        | 40EFOZCJ | 50EFOZCJ |
| Specification Sheet, Pleasure Craft Models: EOZDJ/EFOZDJ | G2-152                | G2-159  | G2-160 | G2-153   | G2-154   |
| Specification Sheet, Commercial Models: EOZCJ/EFOZCJ     | G2-161                | G2-168  | G2-169 | G2-162   | G2-163   |
| Marine Safety Precautions                                | TP-5620               |         |        |          |          |
| Installation Manual                                      | TP-6862               |         |        |          |          |
| Service Manual—Generator                                 | TP-6863               |         |        |          |          |
| Parts Catalog *  | TP-6864               |         |        |          |          |
| Operation Manual—Engine                                  | TP-6444               |         |        | TP-6889  |          |
| Service Manual—Engine                                    | TP-5854               |         |        |          |          |
| Service Manual, Fuel System—Engine                       | TP-6829               | TP-6830 |        | TP-6454  |          |
| Modbus® Communications Protocol Operation Manual         | TP-6113               |         |        |          |          |
| SiteTech™ Software Operation Manual                      | TP-6701               |         |        |          |          |
| * Includes the generator and engine information.         |                       |         |        |          |          |

| Literature Type  | Pleasure Craft Models |          |           |           |
|--|-----------------------|----------|-----------|-----------|
|  | 80EOZDJ               | 99EOZDJ  | 125EOZDJ  | 150EOZDJ  |
|  | 70EFOZDJ              | 80EFOZDJ | 100EFOZDJ | 125EFOZDJ |
|  | Commercial Models     |          |           |           |
|  | 80EOZCJ               | 99EOZCJ  | 125EOZCJ  | 150EOZCJ  |
|  | 70EFOZCJ              | 80EFOZCJ | 100EFOZCJ | 125EFOZCJ |
| Specification Sheet, Pleasure Craft Models: EOZDJ/EFOZDJ | G2-155                | G2-156   | G2-157    | G2-158    |
| Specification Sheet, Commercial Models: EOZCJ/EFOZCJ     | G2-164                | G2-165   | G2-166    | G2-167    |
| Marine Safety Precautions                                | TP-5620               |          |           |           |
| Installation Manual                                      | TP-6862               |          |           |           |
| Service Manual—Generator                                 | TP-6863               |          |           |           |
| Parts Catalog *  | TP-6864               |          |           |           |
| Operation Manual—Engine                                  | TP-6889               |          |           |           |
| Service Manual—Engine                                    | TP-5854               |          |           |           |
| Service Manual, Fuel System—Engine                       | TP-6456               |          |           |           |
| Modbus® Communications Protocol Operation Manual         | TP-6113               |          |           |           |
| SiteTech™ Software Operation Manual                      | TP-6701               |          |           |           |
| * Includes the generator and engine information.         |                       |          |           |           |

**Figure 1-2** Generator Set Literature

# Section 1 Specifications and Features

## 1.1 Introduction

The specification sheets for each generator set provide specific alternator and engine information. Refer to the respective specification sheet for data not supplied in this manual. Consult the generator set operation manual, installation manual, engine operation manual, and engine service manual for additional specifications.

A permanent magnet alternator is identified with one of the following designations: 4P\_X, 4Q\_X, 4R\_X, 4S\_X, or 4T\_X. Example: Gen. Model 4S12X. The first alpha character (S) identifies the alternator family and the last character (X) denotes the Fast-Response™ X alternator.

The generator set has a rotating-field alternator with a smaller rotating-armature alternator turned by a common shaft. The main rotating-field alternator supplies current to load circuits while the rotating-armature (exciter) alternator supplies DC to excite the main alternator's field.

The generator set has a 4-pole, rotating-field with brushless, permanent magnet alternator excitation system. The PM system provides short-circuit excitation current up to 300% at 60 Hz (approximately 275% at 50 Hz) for a minimum of 10 seconds to allow selective circuit breaker tripping.

Voltage regulation is provided by the generator set controller. Refer to the Service Manual for additional voltage regulator information.

## 1.2 Permanent Magnet Alternator Concept

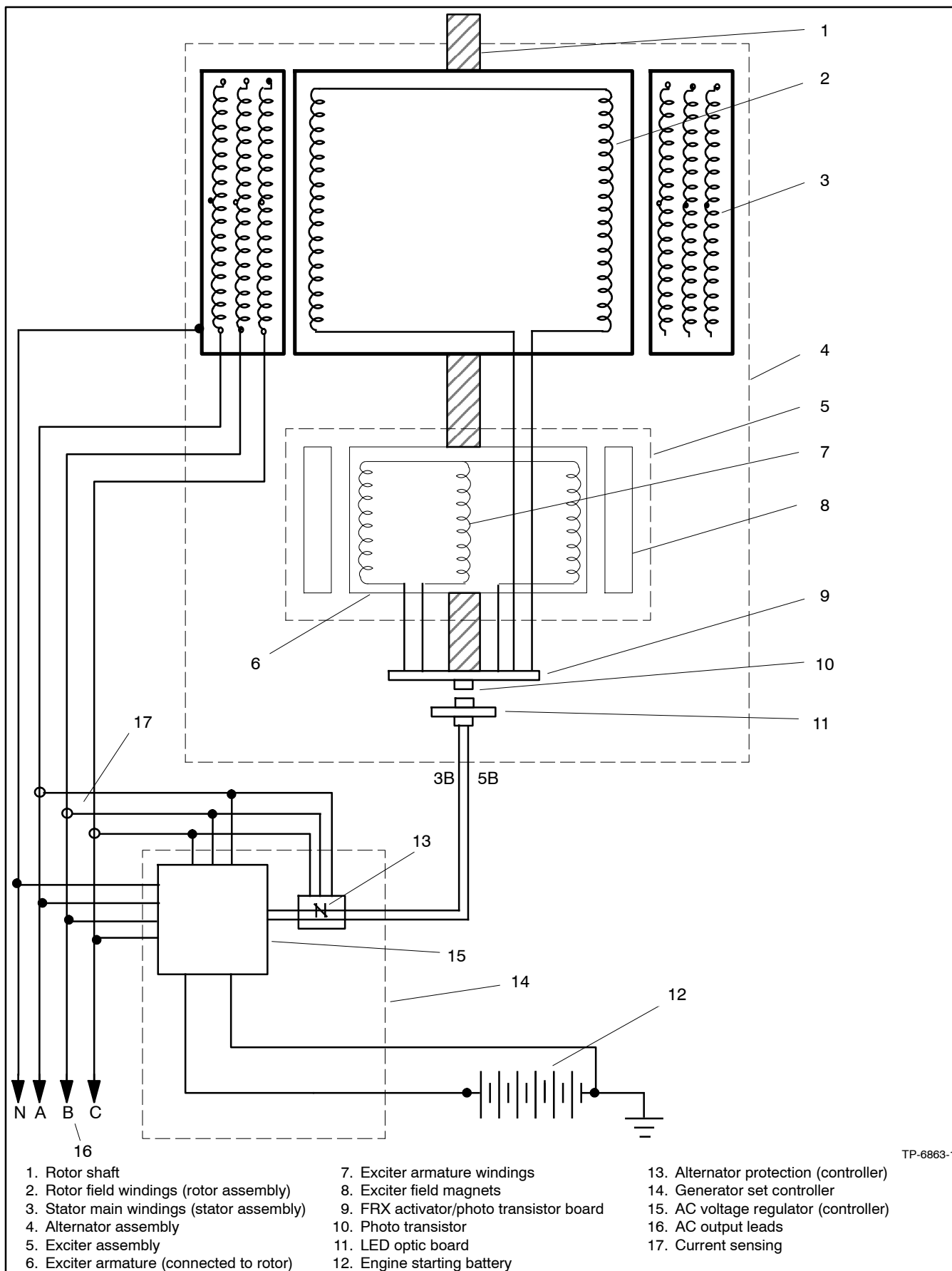
The alternator excitation system uses a permanent, rare-earth magnet exciter with a silicon controlled rectifier (SCR) assembly which controls the amount of DC current fed to the alternator field. This type of system uses a voltage regulator (located within the Decision-Maker® 3500 controller) which provides a signal to control the SCR assembly through an optical coupling. The voltage regulator monitors engine speed and alternator output voltage to turn a stationary light emitting diode (LED) on or off, according to engine speed and output voltage. The LED is mounted on the end bracket opposite a photo transistor board which rotates on the shaft. The photo transistor picks up the signal from the LED and tells the SCR assembly to turn on or off, depending upon the need, as dictated by the voltage regulator. See Figure 1-1.

The voltage recovery period of this type of alternator is several times faster than the conventionally wound field brushless alternator because it does not have to contend with the inductance of the exciter field. It also has better recovery characteristics than the static excited machine because it is not dependent upon the generator set output voltage for excitation power. Possibly the greatest advantage of this type machine is its inherent ability to support short-circuit current and allow system coordination for tripping downstream branch circuit breakers.

The alternator system delivers exciter current to the main field within 0.05 seconds of a change in load demand.

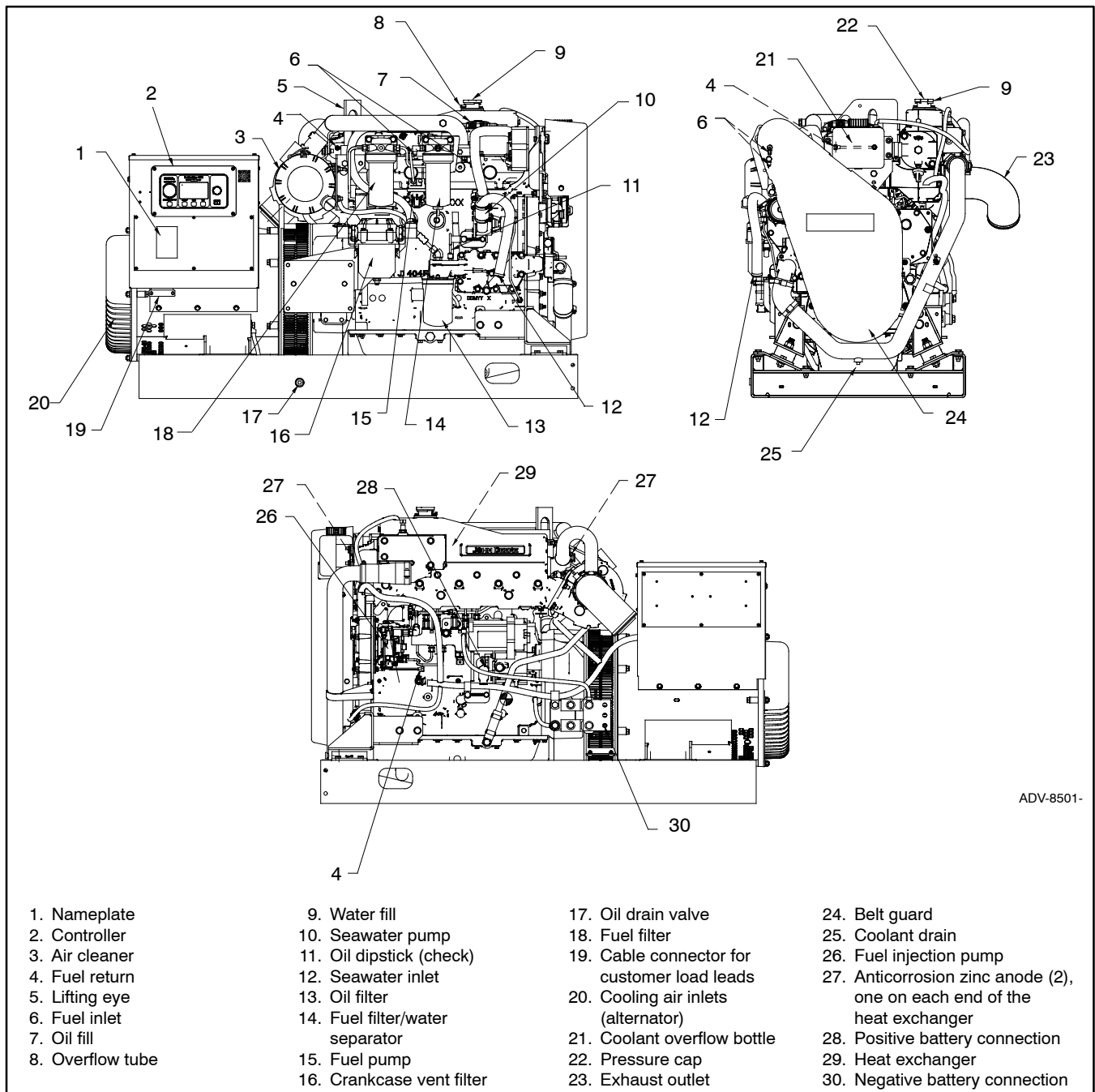
## 1.3 Short Circuit Performance

When a short circuit occurs in the load circuit(s) being served, output voltage drops and amperage momentarily rises to 600%–1000% of the generator set's rated current until the short is removed. The SCR assembly sends full exciter power to the main field. The alternator then sustains up to 300% of its rated current. Sustained high current will cause correspondingly rated load circuit fuses/breakers to trip. The *controller alternator protection* feature serves to collapse the alternator's main field in the event of a sustained heavy overload or short circuit.

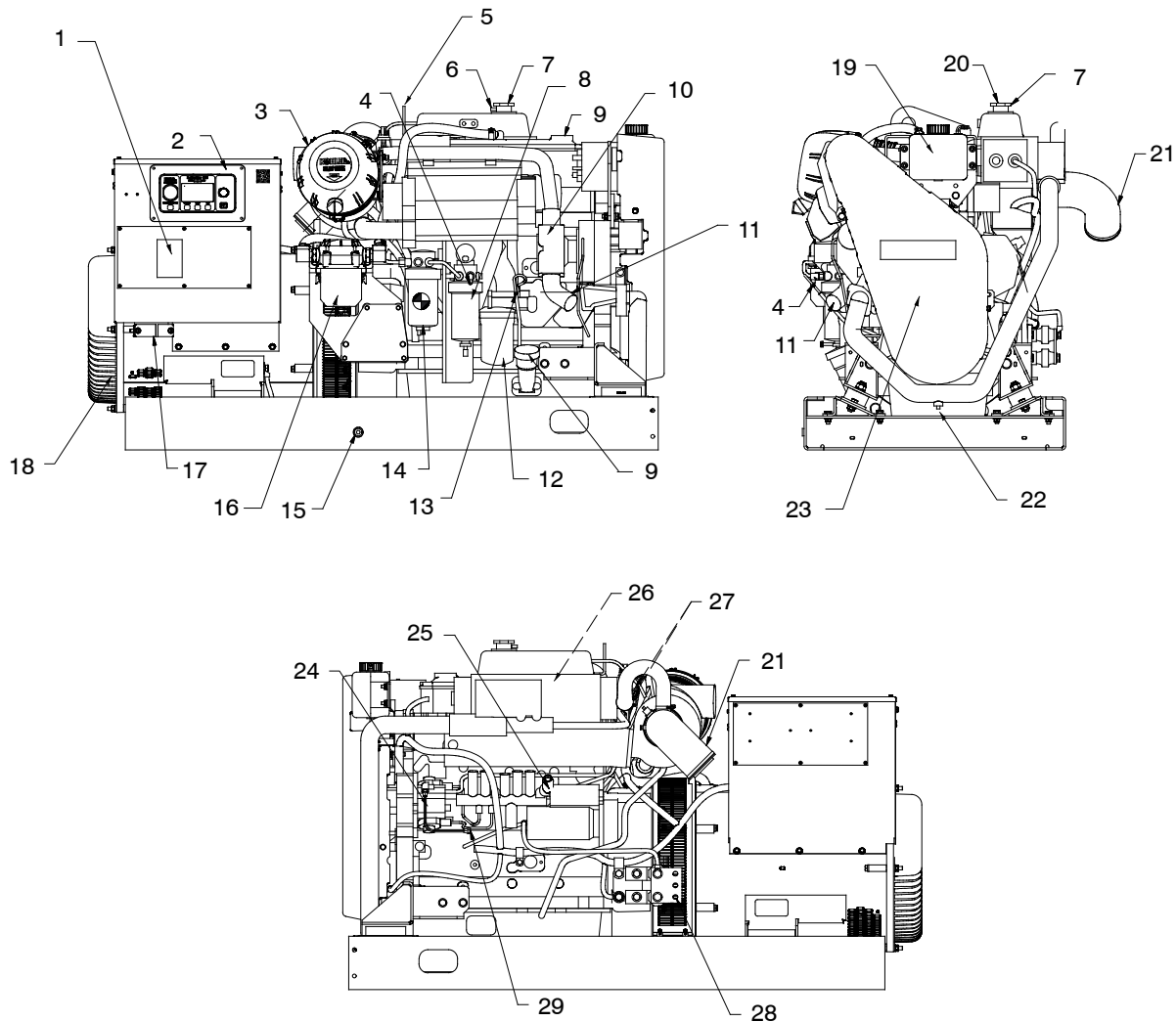


**Figure 1-1** Alternator Schematic

## 1.4 Service Views



**Figure 1-2** Service Views, Typical (65EOZD(C)J/55EFOZD(C)J Model Shown)

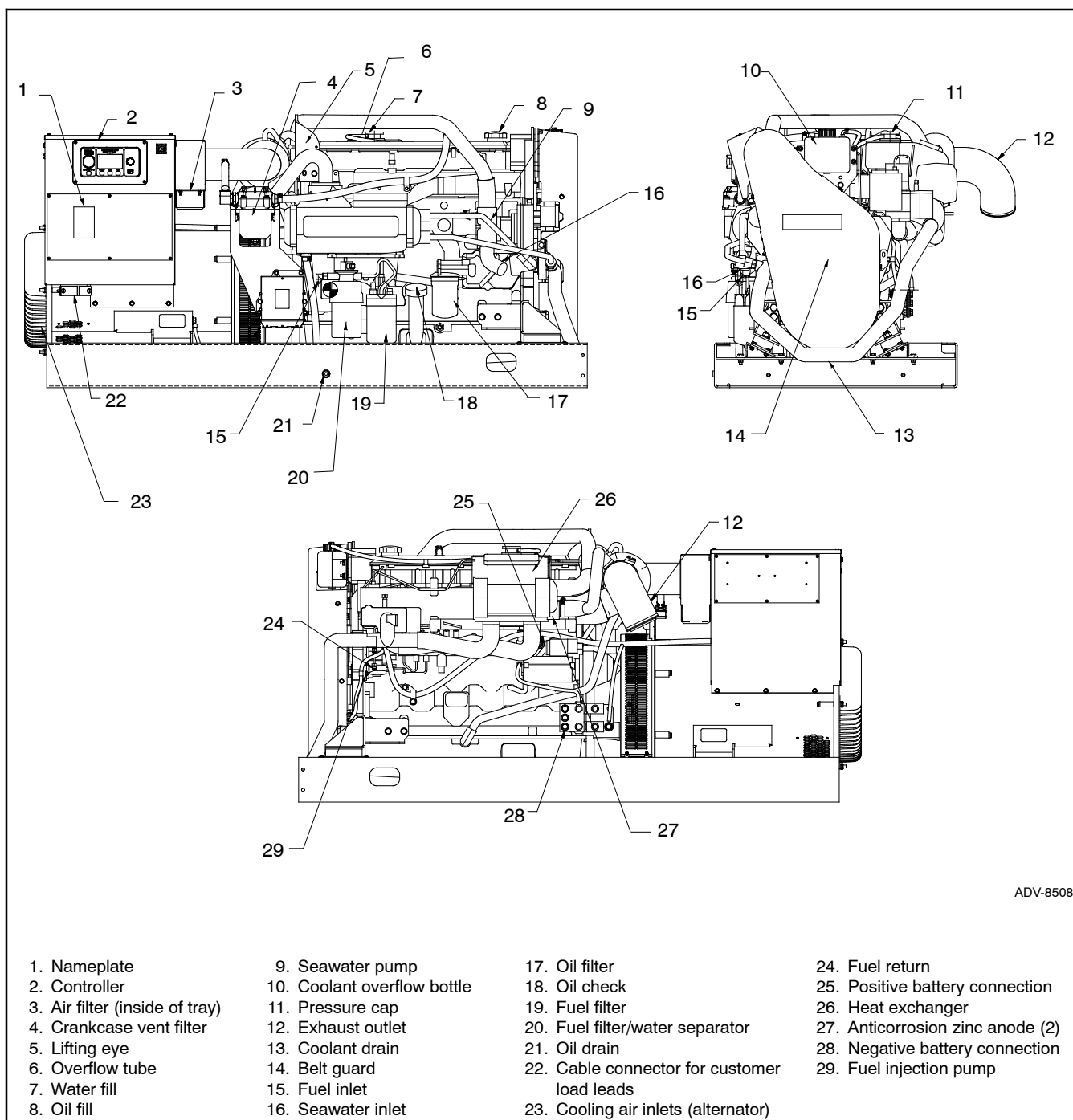


ADV-8506-

- |                                |                           |   |                                  |
|--------------------------------|---------------------------|---|----------------------------------|
| 1. Nameplate                   | 9. Oil fill               | 17. Cable connector for customer load leads | 24. Fuel injection pump          |
| 2. Controller                  | 10. Seawater pump         | 18. Cooling air inlets (alternator)         | 25. Positive battery connection  |
| 3. Air cleaner                 | 11. Seawater inlet        | 19. Coolant overflow bottle                 | 26. Heat exchanger               |
| 4. Fuel inlet                  | 12. Oil filter            | 20. Pressure cap                            | 27. Anticorrosion zinc anode (2) |
| 5. Lifting eye                 | 13. Oil check             | 21. Exhaust outlet                          | 28. Negative battery connection  |
| 6. Overflow tube               | 14. Fuel filter           | 22. Coolant drain                           | 29. Fuel return                  |
| 7. Water fill                  | 15. Oil drain             | 23. Belt guard                              |                                  |
| 8. Fuel filter/water separator | 16. Crankcase vent filter |   |                                  |

**Figure 1-3** Service Views, Typical (99EOZD(C)J/80EFOZD(C)J Model Shown)





**Figure 1-4** Service Views, Typical (150EOZD(C)J/125EFOZD(C)J Model Shown)

## 1.5 Introduction

The spec sheets for each generator set provide model-specific generator and engine information. Refer to the respective spec sheet for data not supplied in this manual. Refer to the generator set service manual, installation manual, engine operation manual, and engine service manual for additional specifications.

## 1.6 Controller Specifications

| Decision-Maker® 3500                 |  |
|--------------------------------------|--|
| Power source with circuit protection | 12- or 24-volt DC                            |
| Power drain                          | 400 milliamps at 12V<br>200 milliamps at 24V |
| Humidity range                       | 5-95%  |
| Operating temperature                | -40° to 70°C (-40° to 158°F)                 |
| Storage temperature                  | -40° to 85°C (-40° to 185°F)                 |

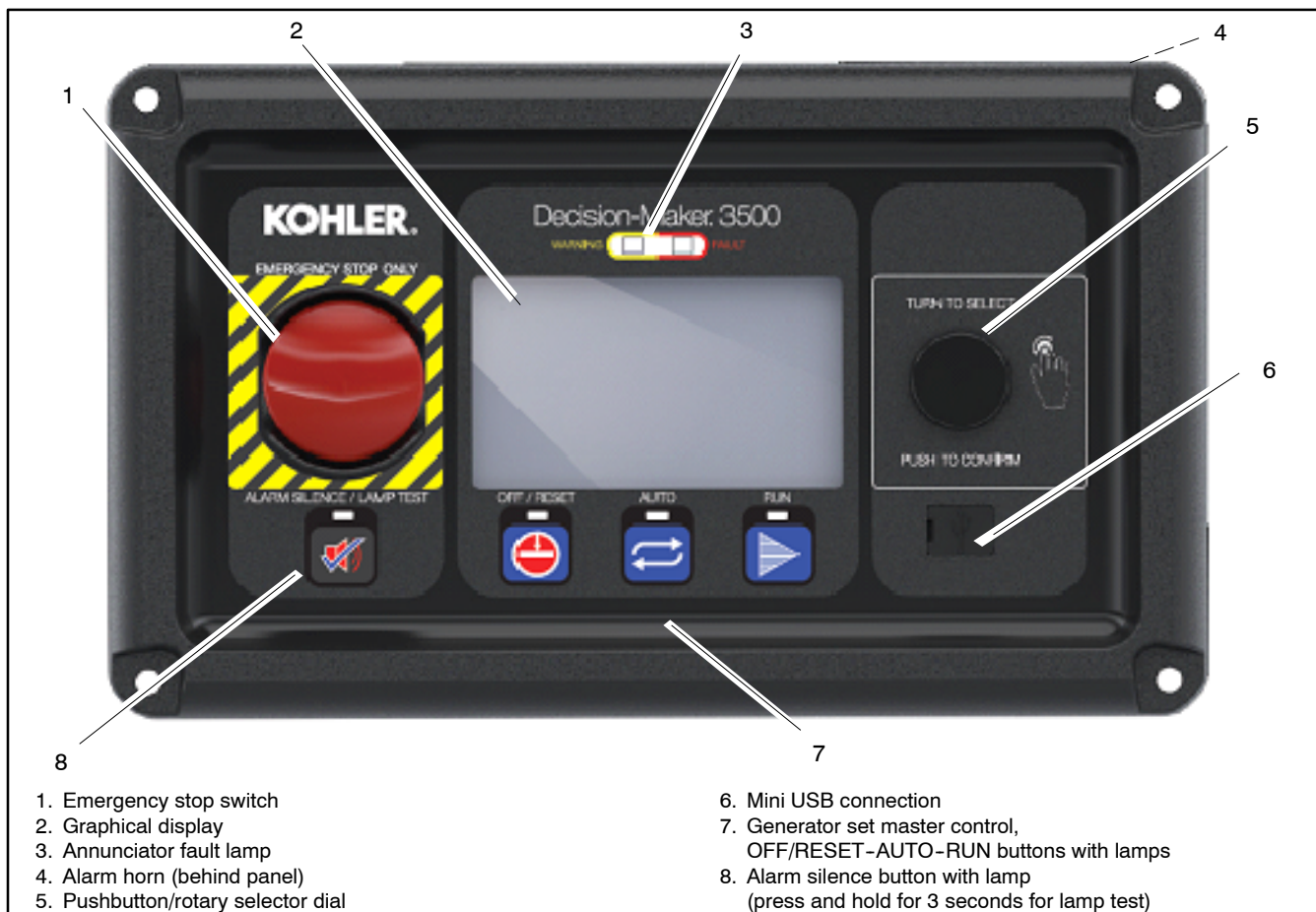
**Note:** Have setup and adjustments of the Decision-Maker® 3500 controller performed only by an authorized Kohler distributor/dealer. The setup and adjustments are password protected.

## 1.7 Controller Features

The controller features include the annunciator lamp, graphical display and pushbutton/rotary selector dial, switches and controls, and terminal blocks. See Figure 1-5 for an illustration of the controller front panel. The following paragraphs detail the features by general topics. The controller provides:

- The backlit LCD (liquid crystal display) for monitoring the generator set functions and output values
- Master control buttons with status lights
- Fault lamp
- Pushbutton/rotary selector dial to navigate the generator set displays
- Alarm horn and alarm silence switch/light
- Mini USB connector for PC setup using SiteTech™ software

The controller features, accessories, and menu displays depend upon the engine electronic control module (ECM) setup and features. Controller features apply to generator set models with ECM and non-ECM engines unless otherwise noted.



**Figure 1-5** Decision-Maker® 3500 Controller with Digital Display and Pushbutton/Rotary Selector Dial

**Note:** Press the pushbutton/rotary selector dial to turn on the controller lights and display. The backlight turns off 60 minutes after the last entry when in the AUTO mode.

**Note:** After about 15 minutes of no user input (pushbutton/rotary selector dial or buttons), the menu is reset to the top of the main menus and auto-paging activates for the Overview submenus.

**Note:** Measurements display in metric or English units. Use the Controller Configuration menu to change the measurement display.

### 1.7.1 Switches and Controls

**Note: US/Metric Display** is selectable in Section 1.10—Controller Configuration Menu.

**Alarm Horn.** The alarm horn alerts the operator or other attendants that a warning or shutdown condition exists.

**Alarm (Horn) Silence.** The alarm silence switch silences the alarm horn at the operator's discretion. Press the master control switch AUTO button *before* pressing the alarm silence button. The alarm horn cannot be silenced unless the master control switch AUTO button is pressed.

**Note:** Additional alarm silencing options are shown in Section 1.10—Controller Configuration Menu.

Restore alarm horn switches at all locations including those on remote annunciator kits after correcting the fault shutdown to avoid reactivating the alarm horn. See Section 2—Operation, 2.6.6 Controller Resetting for resetting the controller.

**Emergency Stop.** The operator-activated pushbutton immediately shuts down the generator set in emergency situations. Reset the emergency stop switch after shutdown by pulling the emergency stop switch outward. *Use the emergency stop switch for emergency shutdowns only.* Use the master control switch OFF/RESET button for normal shutdowns.

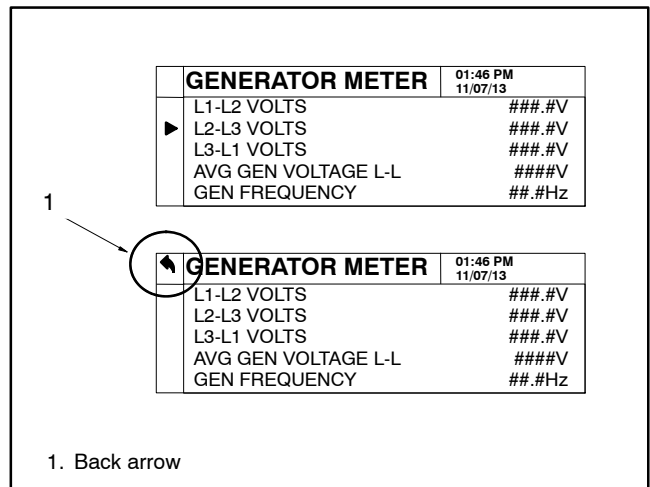
**Generator Set Master Control (OFF/RESET-AUTO-RUN).** These buttons reset the controller fault lamps and start/stop the generator set. Additional information is shown in Section 2—Operation.

**Lamp Test.** Press and hold the Alarm Silence/Lamp Test button to test the controller indicator lamps, alarm horn, and digital display.

**Pushbutton/Rotary Selector Dial.** This control provides access to the menus for monitoring. Press the selector dial to activate the graphical display and to select choices shown on the display. Rotate the dial to navigate through the menus.

The pushbutton/rotary selector dial has several features and functions:

- Momentarily press the dial to activate the graphical display if dark.
- Rotate the dial to navigate through the main menus—turn counterclockwise to go forward (down) and clockwise to go back (up). The menus wrap to the beginning.
- Press the dial at a given main menu to access the submenu within the selected main menu.
- When in the submenu, rotate the dial to navigate through the submenu—counterclockwise to go forward (down) and clockwise to go back (up). The menus wrap to the beginning.
- Momentarily press the dial when in the submenu to make a user selection choice (if available) or to go back to the respective main menu.
- To return to the previous menu, rotate the dial (counterclockwise or clockwise) until the back arrow appears in the upper left corner and press the dial.



**Figure 1-6** Back Arrow Location

- After about 15 minutes of no user input (pushbutton/rotary selector dial or buttons), the menu resets to the top of the main menus and auto-paging activates for the Overview submenus.

## 1.7.2 Annunciator Lamps

The controller has a single annunciator fault lamp providing visual generator set status. In addition, each button has a lamp. See Figure 1-7.

| Lamp/Button          | Lamp Color                         |
|----------------------|------------------------------------|
| Alarm (Fault) Lamp   | Yellow (Warning) or Red (Shutdown) |
| Off/Reset Button     | Blue                               |
| Auto Button          | Blue (System Ready)                |
| Run Button           | Blue                               |
| Alarm Silence Button | Orange                             |

**Figure 1-7** Annunciator Lamps

### System Status Lamps (Master Control Switches)

The lamp illuminates on the master control switch AUTO (automatic start) button indicating the system senses no faults and the unit is ready to start by remote command.

The lamp illuminates on the master control switch OFF/RESET button indicating the generator set is stopped.

The lamp illuminates on the master control switch RUN button indicating the generator set is cranking or running from a local command.

Only one of the three master control switch lamps will illuminate at any given time.

**Alarm Silence Lamp.** Orange lamp illuminates indicating the alarm horn was silenced.

**Alarm Fault Lamp.** Yellow lamp illuminates indicating a warning condition or red lamp illuminates indicating a shutdown condition. See System Warning Fault Lamp and System Shutdown Fault Lamp following for system fault conditions.

**System Warning Fault Lamp.** Yellow lamp identifies an existing fault condition that does not shut down the generator set. A continuing system warning fault condition may cause a system shutdown. Correct all system warnings as soon as practical.

See Section 2.6.3, System Fault Warning Lamp with Digital Displays, for definitions of the items listed.

**System Shutdown Fault Lamp.** Red lamp indicates that the generator set has shut down because of a fault condition. The unit will not start without resetting the controller, see Section 2.6.6, Controller Resetting procedure.

See Section 2.6.4, System Fault Shutdown Lamp with Digital Displays, for definitions of the items listed.

## 1.7.3 Graphical Display

Press the pushbutton/rotary selector dial to turn on the controller lamps and display. The backlight turns off 60 minutes after the last entry when in the AUTO mode.

The generator set must be running for some displays to indicate values. If the generator set is not running some values will display zero or N/A (not available).

The 5-line, 35 character per line backlit heated display provides generator set and engine data, system status, and fault information. See Figure 1-5. The graphical display shows abbreviations in some instances.

**Note: US/Metric Unit Display** is selectable in the Controller Configuration menu.

**Note:** After about 15 minutes of no user input (pushbutton/rotary selector dial or buttons), the menu resets to the top of the main menus and auto-paging activates for the Overview submenus.

The main menus are listed below. Within each main menu are multiple submenus with descriptions following.

- Metering (See Section 1.8)
- Generator Information (See Section 1.9)
- Controller Configuration (See Section 1.10)
- I/O Setup (See Section 1.11)
- Active Events (See Section 2.6.3, Section 2.6.4, and Section 2.6.5)

## 1.8 Metering Menu

### 1.8.1 Generator Metering Submenu

- **Volts** displays the alternator output AC voltages. The display shows all line-to-line and line-to-neutral voltage combinations for three-phase or single-phase configurations. The display also shows the average line-to-line and line-to-neutral voltages.
- **Current** displays the alternator output AC amps. The display shows each line (L1-L2-L3) of three-phase models or L1-L2 current for single-phase models. The display also shows the average current.
- **Frequency (Hz)** displays the frequency (Hz) of alternator output voltage.
- **Power kW** displays the total and the individual L1, L2, and L3 alternator output as actual output values.
- **Power Factor** displays the total and individual line power factor values.
- **% Rated kW** displays alternator output as a percentage of the entered data value.
- **Reactive Power kVAR** displays the total and individual L1, L2, and L3 kVAR.
- **Apparent Power kVA** displays the total and individual L1, L2, and L3 kVA.
- **% Rated kVA** displays alternator kVA as a percentage of the entered data value.
- **Phase Rotation** displays the actual generator rotation.

### 1.8.2 Engine Metering Submenu

**Note:** Not all of these engine metering submenus may apply.

- **Engine Speed (Tachometer)** displays the engine speed (RPM) at which the engine is presently running.
- **Oil Pressure** displays the engine oil pressure.
- **Coolant Temperature** displays the engine coolant temperature.
- **Fuel Rate** displays the calculated fuel consumption rate based on fuel injector outputs (if available from ECM).
- **Gen Battery Voltage** displays the DC voltage of the generator starting battery(ies) as measured by the controller.
- **ECM Battery Voltage** displays the DC voltage of the engine starting battery(ies) as reported from the ECM.
- **Oil Temperature** displays the engine oil temperature.
- **Coolant Pressure** displays for the engine coolant pressure.
- **Fuel Pressure** displays the fuel line pressure at the generator set inlet for gas-powered models.
- **Fuel Temperature** displays the fuel supply temperature.
- **Fuel Used Last Run** displays the accumulated amount of fuel used since last reset (if available from ECM).
- **Crankcase Pressure** displays the engine crankcase pressure.
- **Intake Air Pressure** displays the engine intake manifold air pressure if available.
- **Intake Air Temperature** displays the engine intake manifold air temperature if available.

### 1.8.3 Overview Submenu

#### Generator Status:

- **Average Volts Line-to-Line.** For three-phase configurations the average line-to-line voltage of L1, L2, and L3 is displayed. Single-phase configurations show the L1-L2 voltage.
- **Average Current** value displays as the average for three-phase configurations or the current value for L1-L2 with single-phase configurations.
- **Frequency (Hz)** value displays for the output AC voltage.

#### Engine Status:

- **Coolant Temperature** displays the engine coolant temperature.
- **Oil Pressure** displays the engine oil pressure.
- **Battery Voltage** displays the DC voltage of the engine starting battery(ies).

#### System Status:

- **Fuel Pressure** displays fuel injection pressure.
- **Total Power** displays the generator operating power rating in kW.
- **Engine Run Time** displays the total run time hours.

### 1.8.4 Paralleling Metering Submenu

**Note:** The paralleling metering is only valid if the Decision-Maker® 3500 controller is controlling the circuit breaker.

- **Connected to Bus** displays if the generator is connected to the paralleling bus (the output breaker or contactor is closed).
- **Avg Bus Voltage L-L** displays the average of the three-phase line-to-line voltage measured by the paralleling bus sensing.
- **Avg Gen Voltage L-L** displays the average of the three-phase line-to-line voltage of the generator output.
- **Bus Frequency** displays the cycle frequency of the paralleling bus.
- **Gen Frequency** displays the cycle frequency of the generator.

- **Bus Total Power** displays the real power provided by all the generators in the paralleling system.
- **Bus % of Rated kW** displays the ratio between the Bus Total Power and the Bus Total Capacity (found in the Generator Management screen) expressed as a percentage.
- **Bus % of Rated kVAR** displays the ratio between the reactive load on all generators in the paralleling system and the bus reactive capacity (the sum of 3/4 of the rated kW of all connected generators) expressed as a percentage.

## 1.9 Generator Information Menu

### 1.9.1 Generator Information Submenu

- **Total Run Time** displays the total run time hours.
- **Hours Loaded** displays the total loaded hours.
- **Hours Unloaded** displays the total unloaded hours.
- **kW Hours** displays the total kW hours.
- **Operating Hours** displays the total operating hours.
- **Total Number of Starts** displays the total number of times that the engine was started via the generator set controller.
- **Last Maintenance** displays the date on the controller system clock when the last maintenance was performed.
- **Operating Hours Since Maintenance** displays the total number of hours of operation since the last maintenance date.
- **Starts Since Maintenance** displays the total number of generator set startup events since the last maintenance date.
- **Engine Hours Since Maintenance** displays the total engine hours since last maintenance.
- **Loaded Since Maintenance** displays the total loaded hour since last maintenance.
- **Unloaded Since Maintenance** displays the unloaded hours since last maintenance.
- **kW Hours Since Maintenance** displays the total kW hours since last maintenance.

- **Reset Maintenance Records:** displays a Yes/No choice for the user to select.
- **Last Start** displays the date when the generator set last operated.
- **Last Run Length** displays the length of time that the engine ran the last time it was started via the generator set controller.
- **Controller Serial No.** displays the controller serial number.
- **Software Version** displays the software version number. Use the version number to determine if an upgrade is needed and/or when troubleshooting the controller.
- **ECM Serial No.** displays the ECM serial number.
- **Genset Model No.** displays the generator set model number. Only adjustable from SiteTech™.
- **Genset Spec No.** displays the generator set specification number. Only adjustable from SiteTech™.
- **Genset Serial No.** displays the generator set serial number. Only adjustable from SiteTech™.
- **Alternator Part No.** displays the alternator part number. Only adjustable from SiteTech™.
- **Engine Part No.** displays the engine part number. Only adjustable from SiteTech™.
- **Engine Model No.** displays the engine model number. Only adjustable from SiteTech™.
- **Engine Serial No.** displays the engine serial number. Only adjustable from SiteTech™.

## 1.9.2 Event History Submenu

### Generator Event History:

This menu allows the user to review up to 1000 entries of generator system events including shutdown faults, warning faults, notices, and status events with date and time stamp. See 1.11.1 Controller Fault Diagnostics for a list of the items that appear on the Generator Event History.

### Engine Event Log:

A message is sent each time there is a change in a monitored engine condition (i.e. fault becomes active, fault is cleared). Upon broadcast of this message, the controller will request another message that contains the following information for each fault:

- **SPN (Suspect Parameter Number)** is a four-digit code that represents an engine component.
- **FMI (Failure Mode Indicator)** is a two-digit code that represents the type of fault that occurred (i.e. short circuit, out of range).
- **Occurrence Count** is a count of how many times a fault has occurred.

## 1.9.3 Configuration Submenu

### Generator Configuration

The values in this menu are user-entered for the generator set configuration and are NOT measured values of the generator set.

**Note:** Have setup and adjustments of the Decision-Maker® 3500 controller performed only by an authorized Kohler distributor/dealer. The setup and adjustments are password protected.

- **Operating Mode** displays the programmer entered generator set application configuration as Standby or Prime.
- **Application Type** displays the programmer entered generator set application type as None, Marine, Mobile, Standby or Prime.
- **System Voltage** displays the programmer-entered L1-L2-L3 output voltage for three-phase or the L1-L2 output voltage for single-phase.
- **System Frequency** displays the programmer-entered L1-L2-L3 output voltage frequency for three-phase or the L1-L2 output voltage frequency for single-phase.
- **System Phase** displays the programmer-entered configuration as Single Phase, Single Phase Dogleg, Three Phase Wye, or Three Phase Delta.
- **Rated Engine Speed** displays the programmer entered engine speed in RPM.
- **Adjusted Engine RPM** displays the target engine speed setting.
- **kW Rating** displays the programmer entered kW value for the generator set.
- **kVA Rating** displays the programmer entered kVA value for the generator set.
- **Rated Current** displays the programmer entered current value for the generator set.

- **Battery Voltage** displays the programmer entered battery voltage.
- **Engine Start Delay** displays the time delay before the generator set starts while the master switch is in AUTO or RUN positions.
- **Starting Aid Delay** displays the engine starting aid activation time.
- **Crank On Delay** displays the time allocated for generator set crank on in seconds.
- **Crank Pause Delay** displays the time allocated for generator set crank pause in seconds.
- **Engine Warmed Up** displays the temperature when the engine is warmed up enough to be loaded.
- **Engine Cooled Down** displays the temperature below which the engine cooldown can be overridden.
- **Cooldown Delay** displays the time delay for engine cooldown while the master switch is in the AUTO or RUN positions and not in the idle mode.
- **Cooldown Override** allows the user to select the Cooldown Temperature Override Mode. If set to ON, the engine will stop immediately if the coolant temperature is below the engine cooled threshold, but will run for the duration of the cooldown cycle otherwise. If set to OFF, the engine will always complete the cooldown cycle.
- **Fuel Type** displays the programmer entered fuel type as NG (Natural Gas), LP (Liquefied Petroleum), Gasoline, Diesel, or Unknown.
- **Crank Cycles Limit** displays the programmer entered crank cycle.
- **Enable NFPA Defaults:** Allows the user to Enable or Disable the NFPA defaults.
- **Enable Emergency Battlemode:** Allows the user to turn On/Off the emergency battlemode feature.  
**Note:** Conditional for certain units.

## Protection Configuration

**Note:** The time delays are user adjustable using SiteTech™. Have setup and adjustments of the Decision-Maker® 3500 controller performed only by an authorized Kohler distributor/dealer. The setup and adjustments are password protected.

- **Overvoltage** displays the percentage of the system voltage that the generator voltage must exceed for an overvoltage condition to be indicated.
- **Overvoltage Delay** displays the time that the generator voltage must be in an overvoltage condition before a fault is indicated.
- **Undervoltage** displays the percentage of the system voltage that the generator voltage must drop below for an undervoltage condition to be indicated.
- **Undervoltage Delay** displays the time that the generator voltage must be in an undervoltage condition before a fault is indicated.
- **Overfrequency** displays the percentage of the system frequency that the generator frequency must exceed for an overfrequency condition to be indicated.
- **Underfrequency** displays the percentage of the system frequency that the generator frequency must drop below for an under frequency condition to be indicated.
- **Overspeed** displays the engine speed that the engine must exceed for an overspeed condition to be indicated.
- **Low Battery Voltage** displays the system battery voltage that the battery voltage must drop below for a low battery voltage condition to be indicated.
- **High Battery Voltage** displays the system battery voltage that the battery voltage must exceed for a high battery voltage condition to be indicated.



## 1.9.4 Voltage Regulation Submenu

**Note:** Have setup and adjustments of the Decision-Maker® 3500 controller performed only by an authorized Kohler distributor/dealer. The setup and adjustments are password protected.

The Decision-Maker® 3500 controller has a built-in voltage regulation function. This means that no external voltage regulator is necessary. The voltage regulation of the controller uses Root Mean Square (RMS) sensing for fast response to changes in indicated and regulated voltages resulting in excellent regulation accuracy.

The descriptions of the voltage regulator adjustments and features follow.

**Voltage Adjust.** The voltage adjust allows the user to enter the desired generator set output level. The voltage regulator controls the average of the three output phase voltages to this target in a three phase configuration, and L1L2 voltage to this target in a single phase configuration.

Submenus display the individual line-to-line voltages and the individual phase voltages. These voltages are for reference only and are relevant in unbalanced load conditions. The voltage adjust setpoint can be changed to accommodate an important phase in an unbalanced system.

**Target Voltage.** The voltage that the Decision-Maker® 3500 controller is trying to achieve including droop and paralleling bias.

**Volts/Hz.** The excitation control system includes an under-frequency unloading feature. This is sometimes referred to as Volts-per-Hertz or V/Hz. When the frequency drops below a certain value, the output voltage is reduced to decrease engine load, allowing the engine speed to recover more quickly. The output voltage reduction is based on the frequency.

**Volts per Hz Settings.** The amount of voltage reduction can be adjusted to achieve the desired transient response of the engine and alternator system. The V/Hz function will use the following parameter settings:

- V/Hz Setpoint (Hz)
- V/Hz Slope (%/Hz)
- V/Hz reduction limit (fixed at 50% of rated voltage)

**Volts per Hz Adjustment.** The V/Hz settings can be changed using the PC-based setup program or at the front panel using the password. The setup program will read current settings to determine a similar function when making changes to alternator connections, system voltages or operating frequency.

**Volts/Hz Setpoint.** This adjustment affects the voltage droop (volts per Hz) when load is applied and underfrequency occurs. The volts/Hz setpoint setting defines the threshold below which the underfrequency unloading is active. Any frequency below the setpoint causes the voltage to drop thus reducing the load allowing the engine speed to recover according to the volts/Hz slope setting.

Engine speed recovery depends upon characteristics such as engine make, fuel type, load types, and operating conditions. The volts/Hz setpoint setting is set at the factory to match the engine speed recovery characteristics for the application.

**Volts/Hz Slope.** This setting determines how much the voltage drops during an underfrequency condition. The Volts/Hz Slope setting is set at the factory. Typically, applying a large electrical load causes a dip in engine speed and frequency. The voltage regulator reduces voltage, allowing engine speed recovery. The volts-per-Hz setting determines the degree of unloading that occurs for each 1 Hz decrease in frequency.

**Voltage Droop at 100% kVAR (Reactive Droop).** Reactive droop compensation provides reactive current flow adjustment in the generator set when connected in paralleling applications. Reactive droop reduces excitation levels with increasing reactive current. A reduced excitation level reduces generator set reactive current or generated VARs, improving reactive load sharing.

Enter the parameter as a percentage of system voltage when full-rated load with 0.8 power factor is applied. Any loads less than full load force the voltage to drop by the ratio of reactive volt-amps (VARs) to rated VARs.

**Voltage Gain Adjust.** Regulator gain refers to the gain of the control system. Generally, the higher the gain the faster the system responds to changes and the lower the gain, the more stable the system.

If the voltage is slow to recover when loads are applied or removed, increase the regulator gain. If the voltage is unstable, decrease the regulator gain.

The voltage regulator value is reviewable at all times and provides the ability to fine adjust voltage. Changing the system voltage or replacing the circuit board typically requires a voltage adjustment.

The user can change the individual value or can select *Reset Regulator Defaults?* - Yes to reset to the default value. The *Reset Regulator Defaults* display will only show if editing is enabled.

**Start-Up Ramp Rate.** Slowly ramps the voltage to its target to minimize voltage overshoot at startup.

### 1.9.5 Voltage Selector Switch

The voltage selector switch menu does not apply to the EOZDJ/EFOZDJ and EOZCJ/EFOZCJ models.

### 1.9.6 Paralleling Operation

**Note:** Have paralleling setup performed by appropriately skilled and suitably trained maintenance personnel familiar with generator set operation and service.

The Decision-Maker® 3500 controller is a paralleling controller and provides varying degrees of paralleling functionality.

While the Decision-Maker® 3500 controller can also be used with external switchgear controlling the speed, voltage and paralleling breaker, the Parallel Operation menu is used to configure settings for parallel operation where the controller is communicating on a network with other controllers and provides integral paralleling functionality.

#### Paralleling Setup

The Paralleling Setup menu is intended to configure the basic settings for the parallel operation of the controller. Most of the settings in this menu are configured during commissioning and do not require user adjustment. There are a few settings that may be viewed or adjusted after commissioning is complete.

**Volts-Hz OK Delay.** The time that the voltage and frequency must remain within the acceptable window before the controller considers them to be stable. The voltage window requires the output voltage of the generator to be within the **Voltage OK Pickup** of the system voltage, the frequency window requires the operating frequency of the generator to be within the **Frequency OK Pickup** of the system frequency. This delay may need to be increased if the first generator to close to the bus has not yet reached rated operating parameters or if the speed/voltage is in an overshoot condition when the generator comes online.

**First On Delay.** The time that the system will wait before closing the first generator to the bus. This delay should be set as low as possible, but can be extended to ensure that a different generator will be the first to close. One generator in the system should have the first on delay set to a low number to minimize the delay before the generator can supply power to the load.

**kW Ramp Rate.** The generator will load and unload against the other generators at this rate. The default rate (5%/sec) requires 20 sec to accept 100% load. Increasing the ramp rate will allow the generator to disconnect more quickly from the bus when signal to stop by generator management, but may result in variations in the output voltage or frequency of the generator system. The ramp rate can be decreased if there is noticeable fluctuation in the voltage or frequency when a generator is loading or unloading.

**Trims Enable.** The trims are the mechanism that the paralleling system uses to keep the output voltage and frequency near the rated values when the generator system is operating. The trims default is enabled on all generators, but they can be disabled on some generators in the system to improve load sharing. The trims should be enabled on at least one generator in the paralleling system or the voltage and frequency may drift significantly during the operation of the system.

**Load Enable.** The generator will unload and trip the circuit breaker when this setting is set to OFF. This can be used to force a generator to soft-unload and shut down for service. To keep the breaker from reclosing, the Sync Mode in Auto can be set to OFF (see Sync Mode In Auto below). A generator is not considered for generator management when Load Enable is set to OFF. This parameter should always be returned to ON after the generator has been stopped for service, as it will keep the generator from sharing load or stopping for generator management if it is set to OFF.

**Stand Alone Mode.** This will tell the controller that it is a paralleling controller, even if it does not see another generator on the communication lines. This may be required if all other generator controllers are removed from service for a period of time in which the battery power to this controller will be cycled (the controller remembers that it is in a paralleling system until power is cycled). If the controller sees another controller on the PGEN communication network, this parameter will not change the operation of the system in any way.

**Sync Mode In Auto.** This should be left in Active, but can be used to keep the controller from closing the paralleling breaker to complete a test or to take a generator out of service. Setting the Sync Mode to OFF will disable the synchronizer, the paralleling breaker will not close with the synchronizer disabled. To remove a generator from service manually, set the Sync Mode in Auto to OFF, wait for any additional generators to start, and set the Load Enable to OFF. When the breaker trips, stop the generator by pressing the OFF button, then set the Sync Mode back to Active and the Load Enable back to ON.

**Note:** Pressing the OFF button will also disconnect the generator from the paralleling bus, but it will not give the other generators any opportunity to negotiate an arrangement to support the load. Even if there are enough generators online to support the load, the voltage and frequency may dip when the other running generators are required to pick up the load formerly supported by this generator.

**Sync Mode In Run.** The default setting for this parameter is Check. In Check mode, the controller will close the paralleling breaker to a dead bus (no other generators supplying the load) but will hold synchronism with the bus without closing the paralleling breaker if it is already supplied by another generator. This allows operational verification of the synchronizer, but does not allow the generator to supply the load. If the generator system is to be operated with the engine control switch in Run, the Sync Mode in Run may need to be set to Active.

**Note:** System Start (AUTO-RUN) is the preferred method of operating a generator system. RUN is intended for testing or verification only.

**Note:** Sync Mode in Auto and Sync Mode in Run can also be found on the Synchronizing Setup screen.

## Synchronizing Setup

This screen is primarily used to configure the synchronizer. There is a lot of metering information that can be accessed on this screen, but the parameters should be adjusted only during commissioning.

**Volts-Hz OK.** The voltage and frequency have been within the acceptable window for the Volts-Hz OK Delay.

**In Sync.** The frequency, voltage and phase rotation of the generator have matched that of the bus and the generator and bus have been in phase for the duration of the dwell timer. This value is only updated when the controller is synchronizing (Synch Mode = Active, Passive or Check, breaker is open, generator is running).

**Voltage Matched.** The difference between the generator voltage and the bus voltage is within the acceptable window. This value is only updated when the controller is synchronizing (Synch Mode = Active, Passive or Check, breaker is open, generator is running).

**AVG Bus Voltage L-L.** The average voltage of the paralleling bus.

**AVG Gen Voltage L-L.** The average voltage of this generator.

**Voltage Bias.** The amount that the controller is attempting to adjust the output voltage (100% bias = +10% on the output voltage, -100% = -10% on the output voltage). The controller adjusts the Voltage Bias to match the generator voltage to the bus voltage

**Frequency Matched.** The difference between the generator frequency and the bus frequency is within the acceptable window. This value is only updated when the controller is synchronizing (Synch Mode = Active, Passive or Check, breaker is open, generator is running).

**Bus Frequency.** The operating frequency of the paralleling bus.

**Gen Frequency.** The operating frequency of this generator.

**Speed Bias.** The amount that the controller is attempting to adjust the output frequency of the generator

(100% bias = +5% on the engine speed, -100% = -5% on the engine speed).

The controller adjusts the Speed Bias to match frequency and phase with the paralleling bus.

**Phase Matched.** The phase between the generator voltage and the bus voltage is within the acceptable window. This value is only updated when the controller is synchronizing (Synch Mode = Active, Passive or Check, breaker is open, generator is running).

**Phase Difference.** The phase angle between the generator and the bus.

**Note:** This value is only accurate if the generator is running and the bus is energized. The phase angle must be established between two waveforms.

**Dwell Time Remaining.** The remaining time for the dwell timer in seconds. The generator is considered to be in Sync when the dwell timer expires. If this value is resetting to the Dwell Time (directly above it), the generator is not holding synchronism. This value is only updated when the controller is synchronizing (Synch Mode = Active, Passive or Check, breaker is open, generator is running).

**Sync Time Remaining.** The remaining time before the controller issues a Failure to Synchronize warning. The Failure to Synchronize warning will cause the generator management to consider this generator unreliable and to start another generator (if available). If the system commissioning has been performed properly, this warning should only occur if the system is overloaded or if there is a malfunction on this generator. This value is only populated when the generator is actively synchronizing (Sync Mode = Active, breaker is open, generator is running).

**Note:** Dwell Time Remaining and Sync Time Remaining are not supported on all firmware versions. If the controller firmware does not support the time remaining parameters, they will be populated with N/A.

## Sharing Setup

**Bus % of Rated kW.** The ratio of the total load on the bus (sum of the loads on all connected generators) to the total bus capacity (sum of all the connected generator capacities), expressed as a percentage. This value can be monitored to determine system loading (also found on Bus Metering screen, and Generator Management screen).

**Gen % of Rated kW.** The ratio of the total load on this generator to its rated capacity, expressed as a percentage. This value can be compared to the Bus % of Rated kW (directly above it) to determine if the system is sharing load properly. The acceptable difference between the generator and bus is site-dependent. The adjustment of the parameters on this screen (during commissioning) will determine how closely the generators share load.

**Speed Bias.** The amount that the controller is attempting to adjust the output frequency of the generator

(100% bias = +5% on the engine speed, -100% = -5% on the engine speed).

The controller adjusts the speed bias to share load between the generators connected to the paralleling bus.

**Bus % of Rated kVAR.** The ratio of the total reactive load on the bus (sum of the reactive loads on all connected generators) to the total bus reactive capacity (sum of all the connected generator reactive capacities), expressed as a percentage. This value can be monitored to determine system loading (also found on Bus Metering screen). The Reactive Power rating of the generator is fixed at 3/4 of the rated kW capacity of the generator (even in single-phase applications).

**Gen % of Rated kVAR.** The ratio of the total reactive load on this generator to its rated reactive capacity, expressed as a percentage. This value can be compared to the Bus % of Rated kVAR (directly above it) to determine if the system is sharing reactive load properly. The acceptable difference between the generator and bus is site-dependent. The adjustment of the parameters on this screen (during commissioning) will determine how closely the generators share reactive load. The Reactive Power rating of the generator is fixed at 3/4 of the rated kW capacity of the generator (even in single-phase applications).

**Voltage Bias.** The amount that the controller is attempting to adjust the output voltage of the generator (100% bias = +10% on the output voltage, -100% = -10% on the output voltage). The controller adjusts the voltage bias to share reactive load between the generators connected to the paralleling bus.

**Note:** The metering values in this screen are populated regardless of the state of the generator system, but the system must be in a sharing mode before it will attempt to match generator and bus loading.

## Protective Relays

The protective relays serve two purposes:

1. To protect the generator from damage and
2. To protect the loads supplied by the generator from damage

The protective relays are configured during commissioning and should not be adjusted except by a trained commissioning agent. These settings are often taken into consideration for breaker trip curves, load control settings, and generator management settings. The adjustment without careful consideration of the implications may mask a problem in the system and cause another. Properly-configured protective relays should only trip due to a failure.

**Note:** All protective relay events will trip the breaker, but will not stop the generator until the Trip to Shutdown Delay has expired. During this time, the protective relay which tripped the breaker will be listed under the Active Events, the warning LED will be active, and the generator will remain running. The protective relay can be reset by pressing the AUTO button (note, if the generator is in Run, the protective relay will have to be cleared by stopping the generator). Pressing OFF/RESET or removing the remote start signal to the generator system also clears any active protective relays.

## Gen Management

Generator Management is intended to minimize wear and tear, fuel consumption, pollutant/sound emissions, and generated heat. It acts by signaling each generator to stop when it is unneeded. If generator management for a generator is disabled, the generator will start—generator management failures will result in additional generators running any time the system receives a start signal (this unit or others).

Generator management sequences the generators off in a predetermined order. The highest order generators stop first (when load is low enough) and re-start last (when load is too high). The order can be viewed on the front panel of the controller, but can only be adjusted under certain conditions (see Gen Management Order later in this section).

The time to start a generator (if the load increases) varies with the degree of overload.

The time to stop a generator (if the load is low enough that the generator is no longer needed) varies with the degree of available capacity.

**Note:** Receipt of a start signal will cause all generators to start, synchronize, and close to the bus. Generator management requires that the generators are available (not faulted) in order to be permitted to stop. If a generator is faulted or manually stopped and then placed back in Auto, Generator Management will require the generator to start and connect to the bus before it is considered available (and permitted to stop) again—even if generator management had previously signaled the generator to stop.

**Start Capacity.** The percent of generator rated kW of the running generators that the system allows before the accumulator to start this generator begins filling. ***The Start Capacity is set during commissioning and should not be changed.***

**Start Delay.** The time to decide to start the generator at 10% over capacity. ***The Start Delay is set during commissioning and should not be changed.***

**Stop Capacity.** The percent of generator rated kW of the other running generators that the system allows before the accumulator to stop this generator begins filling. ***The Stop Capacity is set during commissioning and should not be changed.***

**Stop Delay.** The time to decide to stop the generator at 10% available capacity. ***The Stop Delay is set during commissioning and should not be changed.***

## Gen Management Modes

The method that generator management uses to determine the starting and stopping order of the available generators. All the generators in the system must have the same setting for this parameter for the generator management to operate. If this parameter is changed, it will be updated on all the generators which are connected to the PGEN network. This parameter can be set to one of the following:

- **Manual/Fixed.** The order of the generators is manually set. In this mode, the order is set once by the user.

**Note:** The controllers require that the order be valid. If two nodes share a common order or there is a gap in the order sequence, the controllers will attempt to re-sort the order until it is valid. If the order is not valid (automatic re-sorting failed) generator management will be disabled (all generators will run all the time).

- **Run Time.** The generator management start/stop order is determined by the runtime hours on the generators. In this mode, the order is determined to ensure that the generator with the fewest runtime hours is the last to stop. Each subsequent order is assigned to generators with increasing runtime hours.

If a generator is not running, the system will add the Run Time Threshold to the runtime hours for that generator before it considers it in the order—this allows the generators to avoid starting and stopping continuously. The actual runtime will have to differ by more than the threshold to force the generator order to switch (the stopped generator will start, synchronize to the paralleling bus, and begin sharing load—the running generator will soft-unload, disconnect from the bus, cool down and stop).

The generator management order is not user adjustable in runtime mode.

**Note:** If the load on the system requires an additional generator to start, the generator with the most runtime hours will always be the first one to stop if the load decreases enough to permit it (the threshold is no longer taken into consideration as soon as the generator is connected to the paralleling bus).

- **Fuel Level.** The generator management start/stop order of the generators is determined by the level of the fuel in the tank which supplies each generator. In this mode, the order is determined to ensure that the generator with the most fuel is the last to stop. Each subsequent order is assigned to generators with decreasing fuel percentage.

If a generator is running, the system will add the Fuel Level Threshold to the measured Fuel Level for that generator before it considers it in the order. This allows the generators to avoid starting and stopping continuously. The actual fuel level will have to differ by more than the threshold to force the generator order to switch (the stopped generator will start, synchronize to the paralleling bus, and begin sharing load and the running generator will soft-unload, disconnect from the bus, cool down and stop).

The generator management order is not user adjustable in Fuel Level mode.

**Note:** Fuel Level Order Selection mode requires separate fuel tanks for the generators and fuel level senders connected to the controller to operate. Operation of Fuel Level mode without sensors is not defined.

**Note:** If the load on the system requires an additional generator to start, the generator with the lowest fuel level will always be the one to stop (the threshold is no longer taken into consideration as soon as the generator is connected to the paralleling bus).

**Gen Management.** Allows permanent disabling of the generator management on this generator. This parameter can be set individually for each generator and will inhibit the Generator Management Configuration Mismatch Warning for this generator if set to OFF.

**Note:** Disabling the generator management on one generator in a paralleling system will not keep the other generators in the paralleling system from alarming if the generator management configuration of any of the other nodes differs from the disabled generator.

**Note:** Generators with Generator Management disabled are not taking into consideration for generator management on the other generators. It is not recommended to disable any of the generators in a paralleling system where generator management is intended to be used, the generator management may operate too many generators in these cases.

Generator management defaults to OFF. It should be enabled on all generators in the system if it is desired.

**Gen Management Order.** Determines the Start/Stop Order of this generator. Generators with a lower order will start before generators with a higher order, higher order generators stop before lower order generators.

If the Generator Management Order for a generator changes, generator management will start any generators which were involved in the order changing process (including automatic re-sort). After the incoming generators connect to the paralleling bus, the generators with a high enough order to stop will start filling their accumulators to stop.

The generator order is adjustable in Manual/Fixed Order selection mode. It is only adjustable in Runtime or Fuel level mode if the generators have identical runtime or fuel level.

**Total Bus Capacity.** The total bus capacity is simply the sum of the kW rating of all generators that are connected

to the paralleling bus (running with paralleling breaker closed). Generators in Baseload, System Control, or Unload mode are not taking into consideration for this capacity.

**Bus Total Power.** The sum of the power output of all generators which are connected to the bus and available for sharing load. Generators in Baseload, System Control, or Unload mode are not taking into consideration for this level. The Bus Total Power is compared to the Start kW and Stop kW of the generator to determine if the generator should be started, stopped, or remain as-is.

**Start kW.** The threshold of Bus Total Power above which the Start Accumulator for this generator will start filling.

**Note:** The Accumulator fill rate is higher for larger differences between Bus Total Power and Start kW.

**Stop kW.** The threshold of Bus Total Power below which the Stop Accumulator for this generator will start filling.

**Note:** The Accumulator fill rate is higher for larger differences between Stop kW and the Bus Total Power.

**Preemptive Warnings.** A preemptive warning tells the system that a generator may have a problem in the future. If Generator Management has stopped the generators, it will start one of the unused generators but keep the running generator with the preemptive fault online. The following conditions are considered preemptive warnings:

- Low Oil Pressure Warning
- Low Fuel Pressure Warning
- High Coolant Temperature Warning
- Failure to Synchronize Warning
- Water in Fuel Warning
- Fuel Tank Leak Warning
- Loss of Fuel Warning

A preemptive warning disables Generator Management on the unit which has the warning. It will run as long as the start signal is present.

**Note:** Most of the preemptive warnings have a shutdown which follows shortly after the warning. The intent of starting another generator is that it will be able to supply the load when the generator shuts down on a fault.

**Start Accumulator.** The Start Accumulator fills from 0% to 100% while the Bus Total Load remains above the Start kW. This generator will be signaled to start when this accumulator reaches 100%.

**Note:** The Start Accumulator will reset to 0% if the Bus Total Power drops below the Start kW for one second.

The Start Accumulator may be filling while the engine is running in cooldown. If it reaches 100% before the cooldown is complete, the generator will synchronize and close to the bus (it will not have to go through a start sequence).

**Stop Accumulator.** The Stop Accumulator fills from 0% to 100% while the Bus Total Load remains below the Stop kW. This generator will be signaled to stop when this accumulator reaches 100%.

**Note:** The Stop Accumulator will reset to 0% if the Bus Total Power exceeds the Stop kW for one second.

The generator may remain running and connected to the paralleling bus for a few seconds after the Stop Accumulator reaches 0%. During this time, the generator is unloading so that it can trip the circuit breaker connecting it to the bus with minimal wear on the contacts in the breaker and minimal disturbance to the voltage and frequency of the system.

**Run Time Threshold.** The maximum difference in runtime hours that generator management will accept before it re-sorts the Start/Stop Order of the generators to equalize hours (see Gen Management Order earlier in this section). All the generators in the system must have the same setting for the Run Time Threshold for the generator management to operate. If this parameter is changed, it will be updated on all the generators which are connected to the PGEN network.

**Total Run Time.** The actual runtime hours of this generator (to the nearest tenth of an hour). This parameter is also available in the Generator Information screen, but is rounded to the nearest hour.

**Fuel Level Threshold.** The maximum difference in fuel level that generator management will accept before it re-sorts the Start/Stop Order of the generators to equalize fuel level. (See Gen Management Order earlier in this section). All the generators in the system must have the same setting for the Fuel Level Threshold for the generator management to operate. If this parameter is changed, it will be updated on all the generators which are connected to the PGEN network.

**Fuel Level.** The level of the fuel in the tank supplying this generator. This is available in the engine metering section in SiteTech™, but not elsewhere on the User Interface. If no fuel level sensor is connected, this parameter will display N/A. Do not use Fuel Level as the Generator Management Mode if there is no fuel level sensor connected—the operation of the system is not defined in this case.

**Stable Delay.** The time between the system entering a valid generator management state and the time that generator management becomes active.

A valid generator management state requires:

- A Start Signal is present (Local start, remote start, or communications start)
- A least one generator is closed to the paralleling bus
- Generator Management is enabled
- The configuration of vital parameters of the system are identical between all controllers
- No generators have recently failed
- Load control has added priorities through the Min Loads Added Threshold
- The generator management order is valid

Once active, generator management will only go inactive if:

- A generator fails (shuts down with either a fault or user input)
- All generators are disconnected from the bus
- The Start Signal is removed
- Generator Management is disabled
- The configuration on any controller on the network is changed by a user
- The order becomes invalid

All the generators in the system must have the same setting for the stable delay for the generator management to operate. If this parameter is changed, it will be updated on all the generators which are connected to the PGEN network.

**Minimum Gens Online.** Generator Management will always try to keep this many generators online (even if they are not needed). All the generators in the system must have the same setting for the Minimum Gens Online for the generator management to operate. If this parameter is changed, it will be updated on all the generators which are connected to the PGEN network.

The purpose of this setting is to allow configuration to support large transient loads or potential generator failure (N+1 redundancy).

**Note:** Only 1 and 2 Minimum Gens Online is supported at this time.

**Min Loads Added.** The Load Shed priority that must be online before generator management will consider stopping a generator. This is implemented so that generators aren't stopped prematurely (before all the available load has been applied to the system). All the generators in the system must have the same setting for Min Loads Added for the generator management to operate. If this parameter is changed, it will be updated on all the generators which are connected to the PGEN network.

**Note:** Min Loads Added should be set up to support the load control outputs which are connected to actual loads. There is no reason to wait for a load control output to add if no load will be added to the system when it does. At the same time, it is important that all load which the paralleling system will have to support be supplied by the system before generator management makes the determination to stop a generator.

The load control outputs should be capable of shedding enough load that a single generator can support what remains (this should be handled during commissioning, but is included for consideration as loads grow).

## Load Control

Load Control drives 6 outputs (Load Priority 1 Shed through Load Priority 6 Shed) to remove loads from the paralleling bus when the attached generators are unable to support them. See the Load Control Description Section following for more information.

The outputs must be tied to programmable outputs in the configuration before they can be used, but they are controlled internally regardless of output configuration or external connection status.

All generators on the PGEN network initiate load control at the same time and use the same measured values to determine the Add and Shed timing (Bus % kW and Bus Frequency). If the load control settings are set identically, each load control priority will add at the same time on all generators in the paralleling system. This allows Priorities 1 and 2 to be connected to one generator, while Priorities 3 and 4 can be connected to another generator.

**Note:** Load Control in a paralleling system operates identically to the load control on a single generator, except that it takes different metered values into consideration.



## Load Control Description

The purpose of Load Control is to permit a generator to support load which may occasionally exceed the rated capacity of the generator. In paralleling systems, load shed permits the bus to stay at rated voltage and frequency while an additional generator is synchronizing to it. In single-generator applications, load control may shed unimportant but highly demanding loads when the generator is overloaded, preventing a power outage caused by the generator going offline.

The Load Control in the Decision-Maker® 3500 controller supports 6 load control priorities. These priorities generate internal notices for the shed condition. The internal notices are generated any time a load is shed, but they will only operate a load control relay if they are configured to a digital output.

Only 4 load control priorities can be configured to the RDO outputs on the controller (2 in paralleling applications) but the optional 14 relay dry contact kit will permit all 6 load control priorities to be accessed and configured to disconnect 6 different loads (each load priority can interrupt several devices).

In paralleling applications, the load shed priorities can be divided between all the generators. For instance, Generator #1 can support Load Priorities 1 and 4, Generator #2 can support Priorities 2 and 5 and Generator #3 can support Priorities 3 and 6. This configuration does not require the 14 relay dry contact kit and permits partial load shed functionality even if one controller is powered down or fails (redundancy).

Load Priority 1 is shed last and added first, the priorities are added in increasing sequence and shed in decreasing sequence.

All Load Priorities are immediately shed when load control is initiated. Load control is initiated when the system receives a start signal (a system start, a remote start, or a start by communication). In a paralleling application, the controller can receive a start signal from any generator which is connected to the PGEN communication network. Pressing RUN on the controller will not cause the loads to shed.

All loads are added immediately when Load Control is de-activated—this occurs when the start signal is removed.

Load Control adds loads based on the capacity of the system—loads will add more quickly if the available capacity is higher.

Load Control sheds loads based on the degree of overload of the system—loads will shed more quickly as the degree of the system overload increases.

**Note:** The generator management start % should be significantly lower than the Gen Overload Percent so that additional generators will come online before a load is shed.

An under frequency event will also shed load—the under frequency threshold is not adjustable from the User Interface.

The load control will shed subsequent loads more quickly if shedding a load did not remove the overload or underfrequency condition.

In a standard application (single generator or generator controlled by external switchgear) the load control logic uses the Gen % or Rated kW and the Gen Frequency.

In a paralleling application (where the Decision-Maker® 3500 controller is responsible for first-on, synchronizing, load sharing, and generator management) the load control logic uses the Bus % of Rated kW and Bus Frequency. All generators use the same start signal, load and frequency values to determine load control timing, hence each controller will shed and add a given load priority at the same time (provided that the load control settings are identical in each controller).

In a paralleling application where Generator Management is used, some generator sets may be shut down (turned Off) by Generator Management. Even if the generator set is Off, it may de-activate its Load Control outputs to energize those loads. This may seem counter-intuitive, but the generator sets are acting as a system. If voltage and frequency of the paralleling bus are adequate, and Load Add accumulators are met, the loads will be enabled, even if a particular generator set is shut down by the Generator Management.

### Description of User Adjustable Load Control Settings

The Load Control settings are found under GENERATOR INFO -> PARALLEL OPERATION -> LOAD CONTROL. Load control is active, even if the generator is not operating in a paralleling application.

**Gen % Max Cap.** The load level on the generator (or paralleling bus, in a paralleling application) that the load control will not intentionally exceed. If the load is within 15% of this load level, the load control will not add the next priority until the load decreases (or another generator starts, synchronizes and closes its paralleling breaker, in a paralleling application).

**Gen Overload Percent.** The load level on the generator (or paralleling bus, in a paralleling application) above which the load Control will start to consider shedding loads. Loads will shed more quickly if the generator is heavily overloaded, more slowly if the

generator is barely overloaded. If the load drops below the Gen Overload Percent before a load priority is shed, the accumulator for shedding load is reset.

**Note:** Additional load control settings are provided in SiteTech™, but they are configured during commissioning and should not require adjustment after commissioning is complete. Have setup and adjustments of the Decision-Maker® 3500 controller performed only by an authorized Kohler distributor/dealer.

## 1.10 Controller Configuration Menu

### 1.10.1 Controller Configuration Submenu

- **Language** displays the user selected language. At this time, English is the only available option.
- **Units** displays the user selected unit of measure as Metric or English.
- **Time Format** displays the user selected time format as 12 hours or 24 hours.
- **Date Format** displays the user selected date format as mm/dd/yyyy or dd/mm/yyyy.
- **Contrast** displays user selected resolution values to improve digital display clarity.
- **Alarm Silence** displays the programmer selected alarm silence method Always or Auto Only using SiteTech™ software. The Always selection activates the alarm horn in any of the OFF/RESET-AUTO-RUN modes. The Auto Only selection activates the alarm horn only when in the Auto mode.

**Note:** Press the Alarm Silence/Lamp Test button to silence the alarm horn.

### 1.10.2 Communication Setup Submenu

#### Modbus® Communications

The controller communicates using Modbus® as a slave connection with the Modbus® master initiating the communication. The controller seeks the system and alternator parameters and diagnostic information then responds back to the Modbus® master. In addition, the controller accepts information to alter controller parameters including generator set starting and stopping. See Figure 1-8. Refer to the List of Related Materials for available Modbus® literature.

**Note:** Only one Modbus® master can be connected to the controller. Examples include the remote serial annunciator, monitoring software, and switchgear applications.

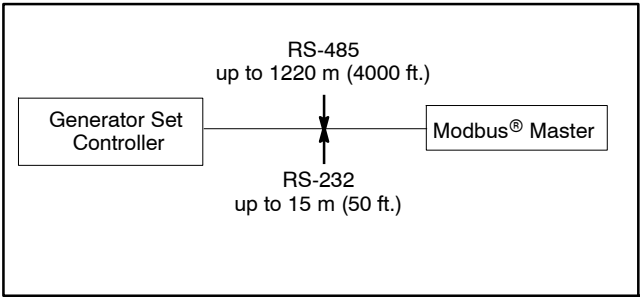


Figure 1-8 Modbus® Connections

A controller can communicate directly to a Modbus® master or participate in a network of devices. It can also be used to interface a local master to a network of devices.

The Modbus® master polls slave devices for data. Controller devices are slaves. Examples of master devices are a personal computer running monitoring software and the remote serial annunciator.

| SiteTech Group | Parameter | Setting   |
|----------------|-----------|---|
| Modbus         | Address   | Use a unique network address between 1 and 247 for each unit. Use 1 for a single connection. Do not use 0 (zero). |
|                | Baud rate | 9600, 19200, 38400, or 57600. Must match the PC and all devices in the system.                                    |

Figure 1-9 Decision-Maker® 3500 Communication Parameters

Select the baud rate. Choose the same baud rate for the Modbus® master, modems, and connected devices. See Figure 1-9.

Each generator set controller must have a unique Modbus® address and PGEN node number (1-4).

**Note:** The PGEN node number is automatically determined. The number of nodes online should match the number of installed generators.

Modbus® is a registered trademark of Schneider Electric.

### 1.10.3 Calibration Submenu

The calibration values are reviewable at all times and provide the calibration of the voltage and current sensing logic. Changing the system voltage or replacing the circuit board requires a calibration adjustment.

**Note:** Have calibration adjustments performed by an authorized Kohler distributor/dealer.

To enable calibration, when the line is highlighted, push and hold the pushbutton/rotary selector dial to enable the calibration capability. The user is prompted with a Yes/No prompt for calibration. The display will show the following:

- Gen L1–L0 Volts
- Gen L2–L0 Volts
- Gen L3–L0 Volts
- Gen L1–L2 Volts
- Gen L2–L3 Volts
- Gen L3–L1 Volts
- Gen L1 Current
- Gen L2 Current
- Gen L3 Current
- Bus L1–L2 Volts
- Bus L2–L3 Volts
- Bus L3–L1 Volts
- Reset Gen Volt Meter: (Yes/No)
- Reset Gen Amp Meter: (Yes/No)
- Reset Bus Volt Meter: (Yes/No)
- Reset All Meters: (Yes/No)

The user can change individual values or can select the individual Reset to reset certain values. The Reset selections will only show if calibration is enabled. Refer to the requirements shown with Generator Set Calibration in 2.6.5 Status and Notice Digital Displays.

To disable calibration, Rotate the pushbutton/rotary selector dial until the <-*Return* popup appears. Momentarily press the pushbutton/rotary selector dial. Stop the generator set if not already done.

## 1.11 I/O Setup Menu

**Note:** Have setup and adjustments of the Decision-Maker® 3500 controller performed only by an authorized Kohler distributor/dealer.

### Analog and Digital Input Setup

There are three types of inputs setups:

1. Analog Resistive
2. Analog Differential (used in paralleling applications)
3. Digital

**Note:** Analog = a sender, variable-resistant device.  
Digital = a switch with contacts.

The I/O Setup Menu displays the setup of digital and analog warning and shutdown inputs. These inputs provide choices for configuring customized auxiliary inputs.

The user must enable the programming mode to edit the display. See Section 2.7 for changeable settings in this menu.

**Descriptions.** Descriptions for user inputs (auxiliary analog or auxiliary digital) may be entered using the SiteTech™ software accessory where the user determines the descriptions.

**Enabled.** This menu indicates whether or not the input is enabled. If the input is not enabled, the controller will ignore this input signal.

**Analog inputs** have separate warning and shutdown enabled choices.

**Inhibit Time Delay.** The inhibit time delay is the time period following crank disconnect during which the generator set stabilizes and the controller does not detect the fault or status event. The controller will ignore the input until the inhibit time expires. If the inhibit time is set to zero, the input is monitored at all times, even when the generator set is not running. The inhibit time delay range is from 0 to 60 seconds.

**Time Delay (shutdown or warning).** The time delay follows the inhibit time delay. The time delay is the time period between when the controller first detects the fault or status event and the controller warning or shutdown lamp illuminates. The delay prevents any nuisance alarms. The time delay range is from 0 to 60 seconds.

**Additional Analog Input Entries.** The analog input selection typically requires entering four values—low warning, high warning, low shutdown, and high shutdown.

## Digital Output and Relay Driver Output Setup

The I/O Setup Menu displays the setup of digital status and fault outputs and relay driver outputs (RDO). These RDO outputs provide choices for configuring customized auxiliary outputs. Additional individual outputs are available for monitoring, diagnostics, and control functions. See Optional Dry Contact Kit following.

The user must enable the programming mode to edit the display. See Section 2.7 for changeable settings in this menu.

**Note:** Changes to the Digital Outputs description requires the use of SiteTech™ software. The digital output can either open or close the circuit to activate.

### Optional Dry Contact Kit

Dry contact kits provide an isolated interconnection between the generator set controller and optional devices. Up to fourteen conditions can be specifically identified with this kit.

A relay coil will be energized when the corresponding engine or generator sensing device or switch monitored by the microprocessor control board is activated.

Each relay provides one set of SPST contacts for field connection of customer supplied indicators or alarms. Contacts are rated for a maximum resistive load of 10A at 120VAC.

The fifteen-relay dry contact board has four digital inputs and two analog inputs. There are fourteen programmable relay outputs and one common fault relay output.

The relay contacts (K1 to K14) are rated:

- 10 amp @ 120 VAC
- 10 amp @ 28 VDC (max.)
- 0.01 amp @ 28 VDC (min.)

The common fault relay contact (K15) is rated:

- 500 mA @ 125 VAC
- 2 amp @ 30 VDC

### 1.11.1 Controller Fault Diagnostics

Figure 1-11 provides descriptions of the system events and their types—warning, shutdown, status, and notice.

**Warnings** show a yellow warning lamp and sound an audible alarm to signal an abnormal condition. A warning does not shut down the unit but indicates attention is required. **Shutdowns** show a red fault lamp, sound an audible alarm, and stop the generator set. **Statuses** do not require user interaction but are part of the event history. **Notices** are used for controlling outputs and notifying the user of the operating status. Notices are NOT part of the event history.

The default selection time delays and digital outputs are factory set and adjustable. Some data entries require using a PC and SiteTech™ software.

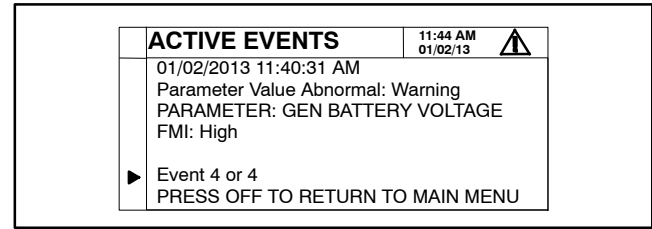


Figure 1-10 Event Screen Capture (Example)

| FMI<br>(Failure Mode Indicator) | Event ID/Parameter at Local Display | Level    | Alarm<br>Horn | Fault<br>Lamp | Programmed<br>Input | Programmed<br>Output |
|---------------------------------|-------------------------------------|----------|---------------|---------------|---------------------|----------------------|
| <b>Protectives</b>              |                                     |          |               |               |                     |                      |
| Low                             | Engine Speed                        | Shutdown | On            | Red           |                     | D                    |
| High                            | Engine Speed                        | Shutdown | On            | Red           |                     | D                    |
| Shorted High                    | Engine Oil Pressure *               | Warning  | On            | Yellow        | AD                  | D                    |
| Shorted High                    | Engine Oil Pressure *               | Shutdown | On            | Red           | AD                  | D                    |
| Shorted Low                     | Engine Oil Pressure *               | Shutdown | On            | Red           |                     | D                    |
| Low                             | Engine Oil Pressure                 | Warning  | On            | Yellow        | AD                  | D                    |
| Low                             | Engine Oil Pressure                 | Shutdown | On            | Red           | D                   | D                    |
| Open Circuit                    | Engine Oil Pressure *               | Shutdown | On            | Red           |                     | D                    |
| Low                             | Engine Coolant Temperature *        | Warning  | On            | Yellow        | AD                  | D                    |
| Low                             | Engine Coolant Temperature *        | Shutdown | On            | Red           |                     | D                    |
| High                            | Engine Coolant Temperature *        | Warning  | On            | Yellow        | AD                  | D                    |
| High                            | Engine Coolant Temperature *        | Shutdown | On            | Red           | AD                  | D                    |
| Open Circuit                    | Engine Coolant Temperature *        | Shutdown | On            | Red           |                     | D                    |
| Shorted High (3)                | Engine Coolant Temperature *        | Shutdown | On            | Red           |                     | D                    |
| Shorted Low (4)                 | Engine Coolant Temperature *        | Shutdown | On            | Red           |                     | D                    |
| High                            | Lube Oil Temperature *              | Warning  | On            | Yellow        | AD                  |                      |
| High                            | Lube Oil Temperature *              | Shutdown | On            | Red           | D                   |                      |
| Low                             | Engine Coolant Level                | Shutdown | On            | Red           | D                   | D                    |
| Low                             | Engine Fuel Level                   | Warning  | On            | Yellow        | AD                  | D                    |
| Low                             | Engine Fuel Level                   | Shutdown | On            | Red           | D                   | D                    |
| High                            | Engine Fuel Level                   | Warning  | On            | Yellow        | D                   | D                    |
| Critically High                 | Engine Fuel Level                   | Warning  | On            | Yellow        | D                   | D                    |
| Low                             | Fuel Pressure                       | Warning  | On            | Yellow        | AD                  | D                    |
| Low                             | Fuel Pressure                       | Shutdown | On            | Red           | AD                  | D                    |
| Low                             | Gen Battery Voltage                 | Warning  | On            | Yellow        |                     | D                    |
| High                            | Gen Battery Voltage                 | Warning  | On            | Yellow        |                     | D                    |
| Low                             | Cranking Voltage                    | Warning  | On            | Yellow        |                     | D                    |
| Low                             | Engine Oil Level                    | Warning  | On            | Yellow        | AD                  | D                    |
| Low                             | Engine Oil Level                    | Shutdown | On            | Red           | D                   | D                    |
| Low                             | Generator Voltage L1-L2             | Shutdown | On            | Red           |                     | D                    |
| High                            | Generator Voltage L1-L2             | Shutdown | On            | Red           |                     | D                    |
| Low                             | Generator Voltage L2-L3             | Shutdown | On            | Red           |                     | D                    |
| High                            | Generator Voltage L2-L3             | Shutdown | On            | Red           |                     | D                    |
| Low                             | Generator Voltage L3-L1             | Shutdown | On            | Red           |                     | D                    |
| High                            | Generator Voltage L3-L1             | Shutdown | On            | Red           |                     | D                    |
| Low                             | Avg Gen Voltage L-L                 | Warning  | On            | Yellow        |                     | D                    |
| High                            | Avg Gen Voltage L-L                 | Warning  | On            | Yellow        |                     | D                    |
| Low                             | Generator Frequency                 | Warning  | On            | Yellow        |                     | D                    |
| High                            | Generator Frequency                 | Warning  | On            | Yellow        |                     | D                    |
| Low                             | Generator Frequency                 | Shutdown | On            | Red           |                     | D                    |
| High                            | Generator Frequency                 | Shutdown | On            | Red           |                     | D                    |

| <b>FMI<br/>(Failure Mode Indicator)</b> | <b>Event ID/Parameter at Local Display</b>                  | <b>Level</b> | <b>Alarm<br/>Horn</b> | <b>Fault<br/>Lamp</b> | <b>Programmed<br/>Input</b> | <b>Programmed<br/>Output</b> |
|---|---|--------------|-----------------------|-----------------------|-----------------------------|------------------------------|
| Low                                     | Total Power (Generator Total Real Power)                    | Warning      | On                    | Yellow                |                             | D                            |
| High                                    | Total Power (Generator Total Real Power)                    | Warning      | On                    | Yellow                |                             | D                            |
| High                                    | Total Power (Generator Total Real Power)                    | Shutdown     | On                    | Red                   |                             | D                            |
| Low                                     | Total Reactive Power  | Warning      | On                    | Yellow                |                             | D                            |
| High                                    | Avg Current   | Warning      | On                    | Yellow                |                             | D                            |
| Low                                     | Maximum Alternator Current                                  | Shutdown     | On                    | Red                   |                             | D                            |
| High                                    | Intake Air Temperature                                      | Warning      | On                    | Yellow                |                             | D                            |
| High                                    | Intake Air Temperature                                      | Shutdown     | On                    | Red                   |                             | D                            |
| High                                    | Fuel Temperature  | Warning      | On                    | Yellow                |                             | D                            |
| High                                    | Fuel Temperature  | Shutdown     | On                    | Red                   |                             | D                            |
| Low                                     | Coolant Pressure  | Warning      | On                    | Yellow                | AD                          | D                            |
|   | AC Sensing Lost   | Warning      | On                    | Yellow                |                             | D                            |
|   | AC Sensing Lost   | Shutdown     | On                    | Red                   |                             | D                            |
|   | Alternator Protection                                       | Shutdown     | On                    | Red                   |                             | D                            |
|   | Auxiliary Input   | Warning      | On                    | Yellow                | AD                          | D                            |
|   | Auxiliary Input   | Shutdown     | On                    | Red                   | D                           | D                            |
|   | Battery Charger Fault                                       | Warning      | On                    | Yellow                | AD                          | D                            |
|   | Ecm Communication Loss                                      | Shutdown     | On                    | Red                   |                             | D                            |
|   | Ecm Model Mismatch  | Shutdown     | On                    | Red                   |                             |                              |
|   | Emergency Stop  | Shutdown     | On                    | Red                   |                             | D                            |
|   | Fuel Tank Leak  | Warning      | On                    | Yellow                | AD                          | D                            |
|   | Fuel Tank Leak  | Shutdown     | On                    | Red                   | D                           | D                            |
|   | Ground Fault Input  | Warning      | On                    | Yellow                | AD                          | D                            |
|   | Locked Rotor  | Shutdown     | On                    | Red                   |                             | D                            |
|   | Electrical Metering Communication Loss                      | Shutdown     | On                    | Red                   |                             |                              |
|   | Over Crank  | Shutdown     | On                    | Red                   |                             | D                            |
|   | Speed Sensor Fault  | Warning      | On                    | Yellow                |                             | D                            |
|   | <b>Other Alerts</b>   |              |                       |                       |                             |                              |
|   | Alarm Horn Silenced   | Status       |                       |                       |                             |                              |
|   | Engine Cool Down Active                                     | Notice       |                       |                       |                             | D                            |
|   | Engine Start Aid Active                                     | Notice       |                       |                       |                             | D                            |
|   | Engine Started  | Status       |                       |                       |                             |                              |
|   | Engine Stopped  | Status       |                       |                       |                             |                              |
|   | Emergency Power System Supplying Load                       | Notice       |                       |                       |                             | D                            |
|   | Generator Running   | Notice       |                       |                       |                             | D                            |
|   | Not In Auto   | Warning      | On                    | Yellow                |                             | D                            |
|   | Option Board 2A Communication Loss                          | Notice       |                       |                       |                             |                              |
|   | Option Board 2B Communication Loss                          | Notice       |                       |                       |                             |                              |
|   | Option Board 2C Communication Loss                          | Notice       |                       |                       |                             |                              |
|   | Remote Start  | Status       |                       |                       |                             |                              |
|   | Load Priority 1 Shed  | Notice       |                       |                       |                             | D                            |
|   | Load Priority 2 Shed  | Notice       |                       |                       |                             | D                            |
|   | Load Priority 3 Shed  | Notice       |                       |                       |                             | D                            |
|   | Load Priority 4 Shed  | Notice       |                       |                       |                             | D                            |
|   | Load Priority 5 Shed  | Notice       |                       |                       |                             | D                            |
|   | Load Priority 6 Shed  | Notice       |                       |                       |                             | D                            |
|   | Cabinet Intrusion Alarm                                     | Warning      | On                    | Yellow                | D                           | D                            |
|   | Reserve Oil Empty   | Warning      | On                    | Yellow                | D                           | D                            |
|   | Stopped By Generator Management                             | Status       |                       |                       |                             | D                            |
|   | Failure To Synchronize                                      | Warning      | On                    | Yellow                |                             | D                            |
| High                                    | Fail To Open Delay  | Warning      | On                    | Yellow                |                             |                              |
| High                                    | Fail To Close Delay   | Warning      | On                    | Yellow                |                             |                              |
| High                                    | Max Close Attempts  | Warning      | On                    | Yellow                |                             |                              |
| Erroneous Data Received                 | Generator Management (Invalid Generator Management Enabled) | Warning      | On                    | Yellow                |                             |                              |

| <b>FMI<br/>(Failure Mode Indicator)</b> | <b>Event ID/Parameter at Local Display</b> | <b>Level</b> | <b>Alarm<br/>Horn</b> | <b>Fault<br/>Lamp</b> | <b>Programmed<br/>Input</b> | <b>Programmed<br/>Output</b> |
|---|--|--------------|-----------------------|-----------------------|-----------------------------|------------------------------|
| High                                    | Trip To Shutdown Delay                     | Shutdown     | On                    | Red                   |                             |                              |
|   | Run Relay Coil Overload                    | Shutdown     | On                    | Red                   |                             |                              |
|   | Starter Relay Coil Overload                | Shutdown     | On                    | Red                   |                             |                              |
| High                                    | System Frequency                           | Warning      | On                    | Yellow                |                             |                              |
| Low                                     | System Frequency                           | Warning      | On                    | Yellow                |                             |                              |
| High                                    | System Voltage                             | Warning      | On                    | Yellow                |                             |                              |
| Low                                     | System Voltage                             | Warning      | On                    | Yellow                |                             |                              |
| Erroneous Data Received                 | System Phase                               | Warning      | On                    | Yellow                |                             |                              |
| <b>ECM Diagnostics</b>                  |  |              |                       |                       |                             |                              |
|   | Engine Derate Active                       | Warning      | On                    | Yellow                |                             |                              |
|   | Injector Wiring Fault                      | Warning      | On                    | Yellow                |                             |                              |
|   | Run Relay Coil Overload                    | Warning      | On                    | Yellow                |                             |                              |
|   | Sensor Supply Voltage                      | Warning      | On                    | Yellow                |                             |                              |
|   | Speed Sensor Fault                         | Warning      | On                    | Yellow                |                             |                              |
|   | Starter Relay Coil Overload                | Warning      | On                    | Yellow                |                             |                              |
|   | Water In Fuel                              | Warning      | On                    | Yellow                |                             |                              |
| <b>Notices Excluded From Display</b>    |  |              |                       |                       |                             |                              |
|   | Common Fault                               | Notice       |                       |                       |                             | D                            |
|   | Common Warning                             | Notice       |                       |                       |                             | D                            |
|   | System Ready                               | Notice       |                       |                       |                             | D                            |
|   | Remote Start Command Issued                | Notice       |                       |                       |                             |                              |
|   | Run Button Acknowledged                    | Notice       |                       |                       |                             |                              |
|   | Contactor                                  | Notice       |                       |                       |                             | D                            |
|   | Close Breaker                              | Notice       |                       |                       |                             | D                            |
|   | Remove Breaker Trip                        | Notice       |                       |                       |                             | D                            |
|   | Standalone Operation                       | Status       |                       |                       | D                           |                              |
|   | Load Enable                                | Status       |                       |                       | D                           |                              |
|   | Baseload Mode                              | Status       |                       |                       | D                           |                              |
|   | System Control Mode                        | Status       |                       |                       | D                           |                              |
|   | System Sync Mode                           | Status       |                       |                       | D                           |                              |
|   | Enable Trims                               | Status       |                       |                       | D                           |                              |

\* Sensor dependent

**Note:** A = Analog, D = Digital

**Figure 1-11** System Events Display Message List

### 1.11.2 Main Logic Circuit Board

The main logic circuit board provides the connection sockets to connect the controller to the engine/generator, input/output connections, optional I/O module kit, and circuit protection fuses. See Section 7 for the circuit board connectors.

#### Circuit Board Connections

**P1 (35-Pin) Connector** for engine/generator wiring harness.

**P2 (14-Pin) Connector** for sensor input connections and relay driver output connections.

**P3 (8-Pin) Connector** for generator set output voltage connection and paralleling bus voltage sensing connections.

**P4 (Ethernet) Connector** connects to a network communication line.

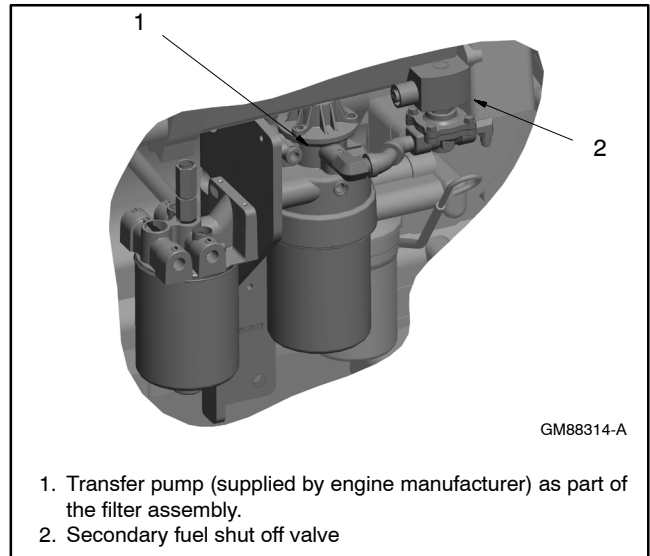
### 1.11.3 For Units Equipped with 3rd Party Marine Option

Additional engine sensors are provided to satisfy 3<sup>rd</sup> party approval requirements. Handling of these redundant sensors is described below:

- All units will have two oil pressure sensors. If the engine is equipped with an ECM, the primary oil pressure sensor (#1) will go to the ECM and the primary oil pressure readings are derived from CAN communications. If the engine is not equipped with an ECM, the primary oil pressure sensor connects to the genset controller at one of the auxiliary analog inputs and primary oil pressure readings will be measured directly by the controller. On all units, the secondary oil pressure sensor (#2) connects to the genset controller at one of the auxiliary analog inputs and secondary oil pressure readings will be measured directly by the controller.
- All units will have a single analog coolant pressure sensor. This sensor connects to the genset controller at one of the auxiliary analog inputs and coolant pressure readings will be measured directly by the controller.
- All units will have a single analog oil temperature sensor. This sensor connects to the genset controller at one of the auxiliary analog inputs and oil temperature readings will be measured directly by the controller.
- All units will have two coolant temperature sensors. If the engine is equipped with an ECM, the primary coolant temperature sensor (#1) will go to the ECM and the primary coolant temperature readings are derived from CAN communications. If the engine is not equipped with an ECM, the primary coolant temperature sensor connects to the genset controller at one of the auxiliary analog inputs and primary coolant temperature readings will be measured directly by the controller. On all units, the secondary coolant temperature sensor (#2) connects to the genset controller at one of the auxiliary analog inputs and the secondary coolant temperature readings will be measured directly by the controller.
- When two sensors are installed (oil pressure and coolant temperature), separate warning messages are initiated for each sensor when a warning limit is exceeded. Should either sensor provide a reading that violates a shutdown limit, a shutdown occurs regardless of the other sensor reading. If either sensor signal is lost, a Loss of Signal (LOS) warning will be initiated. If both sensor signals are lost, a Loss of Signal (LOS) shutdown occurs.

- Every ECM handles their respective sensor readings and values independently and the ECM may send warnings or cause shutdowns on their own. Refer to the respective Engine ECM documentation for unique handling.
- Low coolant pressure and/or loss of coolant pressure readings will cause a warning only (not a shutdown).

All 3rd party marine agency-approved kits include a secondary fuel shut off. A secondary fuel shut off is required for 3rd party approval. See Figure 1-12.



**Figure 1-12** Secondary Fuel Shut Off Valve Location Equipped On Agency-Approved Kits (80–99 kW shown)



### 2.1 Prestart Checklist

To ensure continued satisfactory operation perform the following checks or inspections before or at each startup, as designated, and at the intervals specified in the service schedule. In addition, some checks require verification after the unit starts.

**Air Cleaner.** Check for a clean and installed air cleaner element to prevent unfiltered air from entering the engine.

**Air Inlets.** Check for clean and unobstructed air inlets.

**Air Shrouding.** Check for securely installed and positioned air shrouding.

**Battery.** Check for tight battery connections. Consult the battery manufacturer's instructions regarding battery care and maintenance.

**Coolant Level.** Check the coolant level according to the cooling system maintenance information.

**Note: Block Heater Damage.** The block heater will fail if the energized heater element is not immersed in coolant. Fill the cooling system before turning on the block heater. Run the engine until it is warm, and refill the radiator to purge the air from the system before energizing the block heater.

**Drive Belts.** Check the belt condition and tension of the water pump and battery charging alternator belt.

**Exhaust System.** Check for exhaust leaks and blockages. Check the silencer and piping condition and check for tight exhaust system connections.

Inspect the exhaust system components (exhaust manifold, mixing elbow, exhaust line, hose clamps, silencer, and exhaust outlet) for cracks, leaks, and corrosion.

- Check the hoses for softness, cracks, leaks, or dents. Replace the hoses as needed.
- Check for corroded or broken metal parts and replace them as needed.
- Check for loose, corroded, or missing clamps. Tighten or replace the hose clamps as needed.
- Check that the exhaust outlet is unobstructed.
- Visually inspect for exhaust leaks (*blowby*). Check for carbon or soot residue on exhaust components. Carbon and soot residue indicates an exhaust leak. Seal leaks as needed.
- Ensure that the carbon monoxide detector(s) is (1) in the craft, (2) functional, and (3) energized whenever the generator set operates.

**For your safety: Never operate the generator set without a functioning carbon monoxide detector(s) for your safety and the safety of others on your vessel.**

**Fuel Level.** Check the fuel level and keep the tank(s) full to ensure adequate fuel supply.

**Oil Level.** Maintain the oil level at or near, not over, the full mark on the dipstick.

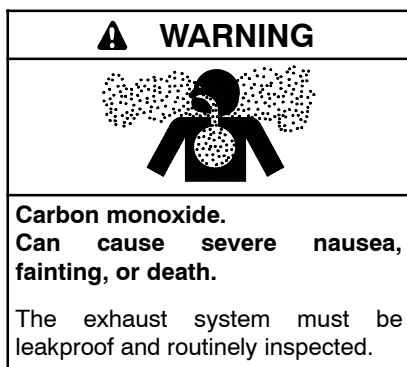
**Operating Area.** Check for obstructions that could block the flow of cooling air. Keep the air intake area clean. Do not leave rags, tools, or debris on or near the generator set.

**Seawater Pump Priming.** Prime the seawater pump before initial startup. To prime the pump: (1) close the seacock, (2) remove the hose from the water-filter outlet, (3) fill the hose and seawater pump with clean water, (4) reconnect the hose to the water filter outlet, and (5) open the seacock. Confirm seawater pump operation on startup as indicated by water discharge from the exhaust outlet.

## 2.2 Marine Inspection

Kohler Co. recommends that all boat owners have their vessels inspected at the start of each boating season by the US Coast Guard, the local Coast Guard Auxiliary, or local state agency.

Kohler Co. also recommends having the generator's exhaust system inspected at the start of each boating season by an authorized Kohler® distributor/dealer. Repair any problems identified before operating the generator set.



**Carbon monoxide symptoms.** Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is a poisonous gas present in exhaust gases. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Carbon monoxide poisoning symptoms include but are not limited to the following:

- Light-headedness, dizziness
- Physical fatigue, weakness in joints and muscles
- Sleepiness, mental fatigue, inability to concentrate or speak clearly, blurred vision
- Stomachache, vomiting, nausea

If experiencing any of these symptoms and carbon monoxide poisoning is possible, seek fresh air immediately and remain active. Do not sit, lie down, or fall asleep. Alert others to the possibility of carbon monoxide poisoning. Seek medical attention if the condition of affected persons does not improve within minutes of breathing fresh air.

**Inspecting the exhaust system.** Carbon monoxide can cause severe nausea, fainting, or death. For the safety of the craft's occupants, install a carbon monoxide detector. Never operate the generator set without a functioning carbon monoxide detector. Inspect the detector before each generator set use.

**Operating the generator set.** Carbon monoxide can cause severe nausea, fainting, or death. Be especially careful if operating the generator set when moored or anchored under calm conditions because gases may accumulate. If operating the generator set dockside, moor the craft so that the exhaust discharges on the lee side (the side sheltered from the wind). Always be aware of others, making sure your exhaust is directed away from other boats and buildings.

## 2.3 Angular Limits During Operation

See Figure 2-1 for angular operation limits for units covered in this manual.

| Model                               | Continuous | Intermittent—<br>3 minutes or less |
|-------------------------------------|------------|------------------------------------|
| 40EOZD(C)J<br>33EFOZD(C)J           | 20°        | 30°                                |
| 40EFOZD(C)J                         | 30°        | 45°                                |
| 50EFOZD(C)J                         |            |                                    |
| 55/65EOZD(C)J<br>45/55EFOZD(C)J     | 35°        | 45°                                |
| 80/99EOZD(C)J<br>70/80EFOZD(C)J     |            |                                    |
| 125/150EOZD(C)J<br>100/125EFOZD(C)J | 25°        | 35°                                |
| Maximum value for all directions    |            |                                    |

Figure 2-1 Angular Limits During Operation

## 2.4 Operation in European Union Member Countries

This generator set is specifically intended and approved for operation below the deck in the engine compartment. Operation above the deck and/or outdoors would constitute a violation of European Union Directive 2000/14/EC noise emission standard.

## 2.5 Load Profile

Whenever operating the generator set, Kohler Co. recommends maintaining the minimum load profile indicated in Figure 2-2. Maintaining the load profile prevents corrosion formation on internal engine components when they're exposed to the breakdown of exhaust gases. Extended light loading may result in engine "wet stacking."

| Minimum Load Requirement | Ideal Load Requirement |
|--------------------------|------------------------|
| 30% load                 | 70% load or more       |

Figure 2-2 Load Profile

**Wet Stacking** occurs when water vapor condenses in the exhaust system. At normal combustion temperatures, water stays vaporized but at low combustion temperatures, it condenses back to a liquid. When running the generator set under normal loads (30% load or more), diesel exhaust stays hot enough to prevent water vapor from condensing. At low load situations, wet stacking can occur.

The operator should perform all of the prestart checks. Start the generator set according to the starting procedure in the controller section of this manual. While the generator set is operating, listen for a smooth-running engine and visually inspect the generator set for fluid or exhaust leaks.

## 2.6 Controller Operation

**Note: Opening seacock.** Before starting the generator set, open the seacock to allow cooling water passage. Failure to do so could damage the seawater pump impeller and cause serious engine overheating damage.

**Note: Transfer switch.** Check that the marine ship-to-shore transfer switch, if equipped, is in the ship position.

**Note: If the generator set does not start after 3 crank attempts (an overcrank fault occurs):**

- 1) **Close the seacock.**
- 2) **Completely drain the water from the exhaust system at the silencer's drain plug.**
- 3) Do not attempt generator set restart.
- 4) Contact an authorized Kohler® distributor/dealer. A water-filled exhaust piping and silencer may further hinder generator starting and cause seawater entry into the engine cylinders through the exhaust valves. Water ingested into the engine may cause major engine damage that the Kohler Co. warranty does not cover.

The controller operation includes several types of starting and stopping functions as detailed below. The controller buttons, lamps, and alarm horn functions are summarized in Figure 2-3.

There are three primary modes of operation, selected by pressing the respective buttons:

- **OFF**
- **RUN**
- **AUTO** (Standby Mode)

When the OFF button is pressed, the generator set is in OFF or goes to OFF and will not start. When the RUN button is pressed, the generator set starts and runs until the OFF or AUTO button is pressed or until a fault is received. When the AUTO button is pressed, the generator set enters the Standby Mode (STANDBY-RUNNING or STANDBY-OFF depending upon the start signal).

- **OFF.** If the generator set was previously running, pressing the OFF button immediately shuts off the generator set, with no engine cooldown. The generator set remains off and will not respond to a remote start signal.
- **RUN—Local Start.** A single generator set starts. No other generator sets in the system will start (or stop).
- **AUTO—Standby or System Ready.** The generator set is waiting for a start signal. The generator set will start and run when a start signal is received via a remote start, local auto-start, or communications-based start.

All generator sets in the system (connected by PGEN and in Standby Mode by pressing AUTO) will start when any one of the generator sets receives a start signal.

Any generator set in the system not in AUTO will not start.

If Generator Management is on, some generator sets may shutdown after a period of time.

With removal of the start signal, all generator sets will shutdown with the appropriate engine cooldown.

- **AUTO-RUN** (Press AUTO and RUN together for a system start signal). All generator sets in the system start and run, close to bus, synchronize, parallel, share load, etc. Some generator sets may shut down after a period of time (indicated by Generator Management) but they remain in Standby Mode ready to start and run if needed.
- **AUTO-OFF** (Press AUTO and OFF together to remove a system start signal, if AUTO-RUN is active). All generator sets in the system open their breakers, enter engine cooldown, shut down, and enter Standby Mode. Closing the remote start contacts accomplishes nothing. Generator sets in the system will enter Standby Mode.

## Start Signal

A start signal includes the following:

- Remote start signal via contacts 3 and 4. An ATS (used during a power outage, exercise period, etc.) or a remote panel used in the vessel take precedence over all other start signals.
- System Start (AUTO-START). Press AUTO and RUN simultaneously to send a start signal.
- Communications-based start message from SiteTech™ or a CAN-based remote panel.

Hardwired contacts (remote start contacts 3 and 4) have priority over all other start signals. If the remote start contacts are activated, the generator sets in the system that are in AUTO, will start and run. If the generator sets were already running, they will remain running but the original source of that start signal will be ignored. The contacts now have control.

## Stop Signal

A stop signal includes the following:

- Removal of start signal via contacts 3 and 4. An ATS (used during a power outage, exercise period, etc.) or a remote panel used in the vessel take precedence over all other start signals.
- System Stop (AUTO-OFF). Press AUTO and OFF simultaneously to send a stop signal to cancel the system start. NOTE: This will not do anything if the system start is not active. Press AUTO and OFF on any controller in the system.
- Communications-based stop message from SiteTech™ or a CAN-based remote panel.

## Engine Cooldown

Cooldown is a state where the generator is running at no load to allow hot engine components time to cool slowly before the engine is stopped. In paralleling applications, this occurs with the circuit breaker open.

When the generator set is running in AUTO mode (AUTO-RUN), an engine cooldown cycle begins when the remote start input is deactivated. Also, if stopping due to a stop signal, a cooldown cycle begins.

If the Cooldown Override is disabled (OFF) in the Generator Configuration Menu, coolant temperature is ignored. The generator will enter cooldown when the start signal is removed, only if the engine control switch is in AUTO. The engine will run for a period of time equal to the Cooldown Delay parameter setting, regardless of the coolant temperature.

If the Cooldown Override is enabled (ON) in the Generator Configuration Menu, coolant temperature will be considered for cooldown. The generator will enter cooldown when the start signal is removed, only if the engine control switch is in AUTO. The engine will run until the coolant temperature is below the Engine Cooled Down parameter setting, or until the Cooldown Delay has expired.

The cooldown cycle lasts for some predetermined amount of time. The cooldown delay is an adjustable parameter. The Engine Cooled Down temperature is not adjustable.

**Note:** No engine cooldown cycle occurs if the OFF button is pressed or if a fault occurs. The shutdown is immediate. If possible, run the generator set without load for 5 minutes to ensure adequate engine cooldown.

**Note:** The alarm horn sounds and the Not-In-Auto Warning display appears whenever the generator set is not in the AUTO mode.

**Note:** The transient start/stop function of the controller prevents accidental cranking of the rotating engine. The generator set stops and recranks when the OFF/RESET button is momentarily pressed and then the RUN button is pressed.

**Note:** The controller provides up to 30 seconds of programmable cyclic cranking and up to 60 seconds rest with up to 6 cycles. The default setting is 15 seconds cranking and 15 seconds rest for 3 cycles. Make cyclic cranking adjustments using SiteTech™ software.

| Button Mode                  | Generator Set Status | Fault Lamp | Alarm Horn | Alarm Silence Button | Alarm Horn Lamp | Controller Display                                |
|------------------------------|----------------------|------------|------------|----------------------|-----------------|---|
| AUTO                         | Off                  | —          | Off        | —                    | —               | Scrolling Overview Menu Only                      |
|                              | On (or Cranking)     | —          | Off        | —                    | —               |   |
|                              | Running and then Off | Red        | On<br>Off  | —<br>Pressed         | —<br>Yellow     | Shutdown Message                                  |
| OFF/RESET                    | Off                  | Yellow     | On         | —                    | —               | Not In Auto Warning                               |
|                              |                      |            | Off        | Pressed              | Yellow          |   |
| RUN<br>(unit fails to start) | Off (or Cranking)    | Yellow     | On         | —                    | —               | Not in Auto Warning                               |
|                              |                      |            | Off        | Pressed              | Yellow          |   |
|                              | Off                  | Red        | On         | —                    | —               | Locked Rotor Shutdown (or other shutdown message) |
|                              |                      |            | Off        | Pressed              | Yellow          |   |
| RUN<br>(unit starts)         | Off (or Cranking)    | Yellow     | On         | —                    | —               | Not in Auto Warning                               |
|                              | On                   |            | Off        | Pressed              | Yellow          |   |
|                              | Running and then Off | Red        | On         | —                    | —               | Shutdown Message                                  |
|                              |                      |            | Off        | Pressed              | Yellow          |   |

**Figure 2-3** Button Function Summary

### 2.6.1 Emergency Stop

Use the controller emergency stop switch for immediate emergency shutdown.

The emergency stop switch bypasses the time delay engine cooldown and immediately shuts down the generator set.

**Note:** Use the emergency stop switch(es) for emergency shutdowns only. Use the generator set OFF/RESET button for normal shutdowns.

The controller fault lamp lights and the unit shuts down when the local emergency stop switch activates.

Use the following procedure to reset the generator set after shutdown by a local or remote emergency stop switch. Refer to Section 2.6.6, Controller Resetting procedure, to restart the generator set following a fault shutdown.

1. Investigate and correct the cause of the emergency stop.
2. Reset the controller emergency stop switch by pulling the switch dial outward.
3. Press the generator set OFF/RESET button.
4. After resetting all faults using the controller reset procedure in Section 2.6.6, press the generator set RUN and/or AUTO button to restart the generator set. The generator set will not crank until the reset procedure completes.

### 2.6.2 System Status Lamps

The (OFF/RESET-AUTO-RUN) buttons indicate the status condition with an integrated lamp at the button.

The lamp illuminates on the AUTO (automatic start) button indicating the system senses no faults and the unit is ready to start by remote command.

The lamp illuminates on the OFF/RESET button indicating the generator set is stopped.

The lamp illuminates on the RUN button indicating the generator set is cranking or running from a local command.

Only one of the three button lamps will illuminate at any given time.

### 2.6.3 System Fault Warning Lamp with Digital Displays

The system FAULT lamp glows yellow and the alarm horn sounds indicating a warning fault but does not shut down the generator set. The fault lamp illuminates yellow and the alarm horn sounds when the fuel tank level on diesel-fueled models approaches empty. This fault requires an optional low fuel level switch for the lamp to function. See Section 2.6.6, Controller Resetting procedure, for instructions on resetting a system warning.

When the system warning lamp is on and no message displays, rotate the dial to the Active Events menu. Press the dial to view messages. Rotate the dial to view additional messages. Press the OFF button to return to the main menu. When the system warning continues, it may lead to a fault and cause a system shutdown.

Use the Silence Alarm button to silence the alarm horn at the operator's discretion.

If the controller is setup for an NFPA 110 application, press the AUTO button before silencing the alarm horn. The alarm horn cannot be silenced unless the button is in the AUTO mode. See 2.6.5 Status and Notice Digital Displays for more information.

**AC Sensing Lost (controller in RUN or AUTO and voltage was never present).** The fault lamp illuminates yellow and the alarm horn sounds when the controller does not detect the nominal generator set AC output voltage after crank disconnect.

**Auxiliary Input.** The fault lamp illuminates yellow and the alarm horn sounds when an auxiliary digital or analog input signals the controller. The digital inputs do not function during the first 30 seconds after startup. Use SiteTech™ software to define inputs as shutdowns or warnings.

**Average Current High.** The fault lamp illuminates yellow and the alarm horn sounds when the generator encounters excessive load or a downstream fault. The output breaker trips. The available sustained fault current of the generator can be obtained from the per-unit transient reactance of the generator and the system voltage and power.

**Average Generator Voltage High.** The fault lamp illuminates yellow and the alarm horn sounds when the generator encounters an over voltage condition. This condition can be caused by a loss of sensing wire, a winding failure, voltage regulator failure, etc. The output breaker trips. The generator may continue to produce excessive voltage until it is shut down.

**Average Generator Voltage Low.** The fault lamp illuminates yellow and the alarm horn sounds when the generator encounters an under voltage condition. This condition can be caused by a loss of a diode on the rectifier bridge, sensing problem, a winding failure, voltage regulator failure, etc. The output breaker trips. The generator may continue to produce insufficient voltage until it is shut down.

**Battery Charger Fault.** The fault lamp illuminates yellow and the alarm horn sounds when the battery charger malfunctions. This fault feature requires an optional battery charger with a malfunction output for the lamp to function.

**Cabinet Intrusion.** The fault lamp illuminates yellow and the alarm horn sounds when the door to the unit was opened.

**Common Warning.** The fault lamp illuminates yellow and the alarm horn sounds when the controller is signaled by a common warning. Use SiteTech™ software to activate the common warning. The common warning comprises all of the warnings under a single alert.

**Critically High Fuel Level (diesel-powered models only).** The fault lamp illuminates yellow and the alarm horn sounds when the fuel tank level on diesel models approaches full. This fault requires an optional critical high fuel switch and fuel tank for the lamp to function.

**ECM Diagnostics (Multiple Engine Inputs).** The fault lamp illuminates yellow and the alarm horn sounds when ECM diagnostics signals the controller. The specific display (xxxxx) will be a brief message or fault code that is engine manufacturer dependant. The engine literature provides the fault code description and further information.

**Failure to Synchronize.** The fault lamp illuminates yellow and the alarm horn sounds when the generator set does not successfully synchronize to the live bus within the time delay as defined in the synchronizing setup menu. The controller will continue attempting to synchronize to the bus after the time delay expires and the warning occurs. Generator Management will start another generator set if this warning occurs.

**Fuel Tank Leak.** The fault lamp illuminates yellow and the alarm horn sounds when the fuel tank signals a leak of the inner tank. This fault requires an optional fuel tank leak switch for the lamp to function.

**Generator Frequency High.** The fault lamp illuminates yellow and the alarm horn sounds when the generator has an overfrequency condition. The output breaker trips. This condition can be caused by various mechanical failures (loss of speed signal to ECU, improperly controlled or inadvertent injection of gaseous fuel etc.).

**Generator Frequency Low.** The fault lamp illuminates yellow and the alarm horn sounds when the generator has an underfrequency condition. The output breaker trips.

**Generator Total Real Power High.** The fault lamp illuminates yellow and the alarm horn sounds when the generator encounters excessive load or a downstream fault. The output breaker trips.

**Generator Total Real Power Low.** The fault lamp illuminates yellow and the alarm horn sounds when the generator is no longer producing power (loss of fuel, bearing failure, fuel system failure, ECU problem, or speed bias connection failure on non-ECM engines). The output breaker trips.

**Ground Fault Input.** The fault lamp illuminates yellow and the alarm horn sounds when a user-supplied ground fault detector signals the controller.

**High Battery Voltage.** The fault lamp illuminates yellow and the alarm horn sounds when the battery voltage rises above the preset level for more than 10 seconds. Figure 2-4 shows high battery voltage specifications. The high battery voltage feature monitors the battery and battery charging system in the generator set operating and off modes.

| Engine Electrical System Voltage | High Battery Voltage Range | High Battery Voltage Default Setting |
|----------------------------------|----------------------------|--------------------------------------|
| 12                               | 13.2-16.2                  | 15                                   |
| 24                               | 26.4-32.4                  | 30                                   |

**Figure 2-4** High Battery Voltage Specs

**High Coolant Temperature.** The fault lamp illuminates yellow and the alarm horn sounds when the engine coolant temperature approaches the shutdown range. The high coolant temperature warning does not function during the preset inhibit time delay period after startup.

**High Fail To Close Delay.** The fault lamp illuminates yellow and the alarm horn sounds when the circuit breaker did not close within the allocated breaker closure time.

**High Fail To Open Delay.** The fault lamp illuminates yellow and the alarm horn sounds when the circuit breaker did not open as quickly as the controller expected.

**High Fuel Level (diesel-powered models only).** The fault lamp illuminates yellow and the alarm horn sounds when the fuel tank level on diesel models approaches near full. This fault requires an optional high fuel switch and fuel tank for the lamp to function.

**High Genset System Frequency.** The fault lamp illuminates yellow and the alarm horn sounds when another generator in the paralleling system has a lower system frequency than this generator. The local display shows System Frequency, FMI: High.

**High Genset System Voltage.** The fault lamp illuminates yellow and the alarm horn sounds when another generator in the paralleling system has a lower system voltage than this generator. The local display shows System Voltage, FMI: High.

**High Intake Air Temperature.** The fault lamp illuminates yellow and the alarm horn sounds when the engine intake air temperature approaches the shutdown range.

**High Lube Oil Temperature.** The fault lamp illuminates yellow and the alarm horn sounds when the engine high oil temperature approaches the shutdown range.

**High Max. Close Attempts** The fault lamp illuminates yellow and the alarm horn sounds when the circuit breaker did not close, even after the controller attempted to close it as many times as specified by the max. close attempts.

**Invalid Generator Management Enabled.** The fault lamp illuminates yellow and the alarm horn sounds when the generator management has been disabled because the generator management configuration of this generator does not match the generator management configuration of another generator that is connected to the same PGEN network. The local display shows Generator Management.

**Invalid Genset Voltage Phase Connection.** The fault lamp illuminates yellow and the alarm horn sounds when another generator in the paralleling system has a different phase connection than this generator. The local display shows System Phase.

**Low Battery Voltage.** The fault lamp illuminates yellow and the alarm horn sounds when the battery voltage drops below a preset level for more than 90 seconds.

| Engine Electrical System Voltage | Low Battery Voltage Range | Low Battery Voltage Default Setting |
|----------------------------------|---------------------------|-------------------------------------|
| 12                               | 9.6-12.6                  | 12                                  |
| 24                               | 19.2-25.2                 | 24                                  |

**Figure 2-5** Low Battery Voltage Specs

The low battery voltage feature monitors the battery and battery charging system in the generator set operating and off modes. The controller logic inhibits the low battery voltage warning during the crank cycle.

**Low Coolant Temperature.** The fault lamp illuminates yellow and the alarm horn sounds when the engine coolant temperature is low. The low coolant temperature warning does not function during the preset inhibit time delay period after startup.

**Low Cranking Voltage.** The fault lamp illuminates yellow and the alarm horn sounds when the battery voltage drops below 60% of the nominal voltage (12 VDC or 24 VDC) for more than 6 seconds during the crank cycle.

**Low Engine Oil Level.** The fault lamp illuminates yellow and the alarm horn sounds because of low engine oil level. This fault feature requires an optional low engine oil level sensor for the lamp to function.

**Low Fuel Level.** The fault lamp illuminates yellow and the alarm horn sounds when the fuel tank level on diesel-fueled models approaches empty. This fault requires an optional low fuel level switch for the lamp to function.

**Low Fuel Pressure.** The fault lamp illuminates yellow and the alarm horn sounds when low fuel pressure occurs. This fault requires an optional low fuel pressure switch for the lamp to function.

**Low Genset System Frequency.** The fault lamp illuminates yellow and the alarm horn sounds when another generator in the paralleling system has a higher system frequency than this generator. The local display shows System Frequency, FMI: Low.

**Low Genset System Voltage.** The fault lamp illuminates yellow and the alarm horn sounds when another generator in the paralleling system has a higher system voltage than this generator. The local display shows System Voltage, FMI: Low.

**Low Oil Pressure.** The fault lamp illuminates yellow and the alarm horn sounds when the engine oil pressure approaches the shutdown range. The low oil pressure warning does not function during first the 30 seconds after startup.

**Not in Auto (Generator Master Control Switches).** The fault lamp illuminates yellow and the alarm horn sounds when the generator set button is in the RUN or OFF/RESET mode.

**Option Board 2X Communication Loss.** The fault lamp illuminates yellow and the alarm horn sounds when the communication with option board 2X (A, B, or C) has been lost.

**Reserve Oil Empty.** The fault lamp illuminates yellow and the alarm horn sounds when the oil makeup kit level has dropped below a threshold.

**Speed Sensor Fault.** The fault lamp illuminates yellow and the alarm horn sounds when the speed signal is absent for one second while the generator set runs.

**Total Reactive Power Low.** The fault lamp illuminates yellow and the alarm horn sounds when the generator has a loss of field condition due to insufficient reactive load production to support real load. The output breaker trips.

## 2.6.4 System Fault Shutdown Lamp With Digital Displays

The system FAULT lamp glows red, the alarm horn sounds, and the unit shuts down to indicate a fault shutdown under the following conditions. See Section 2.6.6, Controller Resetting procedure, for information on resetting a system shutdown.

When the system shutdown lamp is on and no message displays, rotate the dial to the Active Events menu. Press the dial to view messages. Rotate the dial to view additional messages. Press the OFF button to return to the main menu.

Use the Alarm Off button to silence the alarm horn at the operator's discretion. If the controller is setup for an NFPA 110 application, press the AUTO button before silencing the alarm horn. The alarm horn cannot be silenced unless the button is in the AUTO mode. See 2.6.5 Status and Notice Digital Displays for more information.

**AC Sensing Lost (controller in AUTO and voltage was previously present).** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the controller does not detect the nominal generator set AC output voltage for more than 3 seconds after crank disconnect.

**Alternator Protection.** The fault lamp illuminates red and the unit shuts down because of an alternator overload or short circuit. See Appendix D, Alternator Protection for more information.

**Auxiliary Input (Shutdown).** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when an auxiliary digital or analog inputs signals the controller. The digital inputs do not function during the first 30 seconds after startup. Use SiteTech™ software to define inputs as shutdowns or warnings.



**Common Fault.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the controller is signaled by a common fault. Use SiteTech™ software to activate the common fault shutdown. The common fault comprises of any combination of the fault shutdowns under a single alert.

**Coolant Temperature Open Circuit.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the engine coolant temperature sender circuit is open.

**ECM Communications Loss.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the ECM communication link is disrupted.

**ECM Diagnostics (Multiple Engine Inputs).** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when ECM diagnostics signals the controller. The specific display (xxxxx) will be a brief message or fault code that is engine manufacturer dependant. The engine literature provides the fault code description and further information.

**ECM Model Mismatch.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the controller detects an error with the ECM model.

**Electrical Metering Communication Loss.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the metering to the controller communication link is disrupted.

**Emergency Stop.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the local or optional remote emergency stop switch activates.

**Fuel Tank Leak.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the fuel tank signals a leak of the inner tank. This fault requires an optional fuel tank leak switch for the lamp to function.

**Generator Total Real Power High.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the generator set supplies more than 102% of the rated standby output kW (or 112% of the rated prime power output kW) for more than 60 seconds.

**High Coolant Temperature.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down because of high engine coolant temperature. The high coolant temperature shutdown does not function during the preset inhibit time delay period after startup.

**Note:** The high engine temperature shutdown function and the low coolant level shutdown function are independent. A low coolant level condition may not activate the high engine temperature switch.

**High Engine Speed.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down immediately when the governed frequency on 50 and 60 Hz models exceeds the over speed setting.

**High Intake Air Temperature.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down because of high intake air temperature. The shutdown occurs 5 seconds after the engine intake air reaches the temperature shutdown range. The engine intake air temperature shutdown does not function during the first 30 seconds after startup.

**High Generator Frequency.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the frequency is above the overfrequency setting. See Figure 2-6.

| Overfrequency Setting Range | Time Delay | Overfrequency Default Setting |
|-----------------------------|------------|-------------------------------|
| 102%–140% of nominal        | 10 sec.    | 110% of nominal               |

Figure 2-6 Overfrequency Specs

**High Generator Voltage (Each Phase).** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the voltage exceeds the overvoltage setting for the preset time delay period. See Figure 2-7 for overvoltage specifications.

**Note:** Overvoltage can damage sensitive equipment in less than one second. Install separate overvoltage protection on online equipment requiring faster than 2-second shutdown.

| Overvoltage Setting Range | Time Delay Range | Overvoltage Default Setting |
|---------------------------|------------------|-----------------------------|
| 105%–135% of nominal      | 2–10 sec.        | 120% at 2 sec.              |

Figure 2-7 Overvoltage Specs

**High Lube Oil Temperature.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down because of high engine oil temperature. The shutdown occurs 5 seconds after the engine oil reaches the temperature shutdown range. The high engine oil temperature shutdown does not function during the first 30 seconds after startup.

**Locked Rotor (failed to crank).** If none of the speed sensing inputs show engine rotation within the preset time delay of initiating engine cranking, the ignition and crank circuits turn off for the preset period and the cycle repeats. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down after the second cycle of the preset period of cranking.

**Low Coolant Level.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down because of low coolant level. Shutdown occurs 5 seconds after low coolant level is detected.

**Low Engine Oil Level.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down because of low engine oil level. This fault feature requires an optional low engine oil level sensor for the lamp to function.

**Low Engine Speed.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down immediately when the governed frequency on 50 and 60 Hz models drops below the under speed setting.

**Low Fuel Level (diesel-powered models only).** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the fuel tank level on diesel-fueled models approaches empty. This fault requires an optional low fuel level switch for the lamp to function.

**Low Fuel Pressure.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when low fuel pressure occurs. This fault requires an optional low fuel pressure switch for the lamp to function.

**Low Generator Frequency.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the frequency drops below the underfrequency setting. See Figure 2-8 for underfrequency specifications.

| Underfreq. Setting Range | Time Delay                                  | Underfrequency Default Setting |
|--------------------------|---|--------------------------------|
| 80%-95% of nominal       | 10 sec. (short term)<br>60 sec. (long term) | 90% of nominal                 |

**Figure 2-8** Underfrequency Specs

**Low Generator Voltage (Each Phase).** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the voltage drops below the undervoltage setting for the time delay period. See Figure 2-9 for undervoltage specifications

| Undervoltage Setting Range | Time Delay Range | Undervoltage Default Setting |
|----------------------------|------------------|------------------------------|
| 70%-95% of nominal         | 5-30 sec.        | 80% of nominal at 10 sec.    |

**Figure 2-9** Undervoltage Specs

**Low Oil Pressure.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down because of low oil pressure. The shutdown occurs 5 seconds after the low pressure condition is detected. The low oil pressure shutdown does not function during first the 30 seconds after startup.

**Max. Alternator Current Low.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when Alternator Protection Configuration in the personality profile is not correct. The controller may need a new personality profile. Check the voltage, frequency, and connection settings. Consult your local authorized distributor.

**Oil Pressure Open Circuit.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the engine oil pressure sender circuit is open for more than 5 seconds.

**Overcrank.** The fault lamp illuminates red, the alarm horn sounds, and cranking stops when the unit does not start within the defined cranking period. See Section 2.6 for cyclic crank specifications.

**Note:** The controller is equipped with an automatic restart function. When speed drops below 25 Hz (750 rpm) while the engine is running, the unit attempts to recrank. The unit then follows the cyclic cranking cycle and, when the engine fails to start, will shut down on an overcrank fault condition.

**Run Relay Coil Overload.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the current draw on the 70 wire from the controller has exceeded 40 amps or has exceeded 10 amps for at least 10 ms.

**Starter Relay Coil Overload.** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the current draw on the 71 wire from the controller has exceeded 40 amps or has exceeded 10 amps for at least 10 ms.

**Trip to Shutdown Delay** The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the generator is stopped if the circuit breaker has tripped for a Protective Relay function, and the trip to shutdown time delay has expired. This delay allows mitigation of problem conditions without engine shutdown. If the delay expires, it is presumed no successful action was taken in the allotted time.

## 2.6.5 Status and Notice Digital Displays

Warnings and shutdown faults appear on the digital display under the Active Events menu and become part of the event history. Beyond the warnings and shutdowns there are several events which also appear on the digital display under the Active Events menu. Status is an event that is not an alert but is part of the event history. Notice is an alert that is not part of the event history.

The controller allows a selected number of changes by the user for setting up the controller application which are covered in this section.

**Alarm Horn Silence.** This status message indicates whether the alarm horn can be silenced in any button mode (OFF/RESET-AUTO-RUN) or requires the AUTO button be pressed first compliant per NFPA 110. Use SiteTech™ software to change this setting. See Section 2.6.6, Controller Resetting procedure, for information on resetting the system.

The local display shows *Alarm Silence: Always* when the alarm horn can be silenced with the master control buttons in any position (default setting).

The local display shows *Alarm Silence: Auto Only* when the alarm horn can be silenced only when in the AUTO mode. The correct reset sequence requires pressing the OFF/RESET button, then pressing the AUTO button, and then pressing the ALARM SILENCE button.

**Close Breaker.** This notice message indicates that the controller is attempting to close the circuit breaker (a close command is being sent to the circuit breaker). This notice only appears in paralleling applications (where the bus sensing is connected to the bus side of the paralleling breaker).

**Contactor.** This notice message indicates that the controller wants to be connected to the paralleling bus. If a contactor is used for paralleling, this output controls it. This notice only appears in paralleling applications (where the bus sensing is connected to the bus side of the paralleling breaker).

**Emergency Power System (EPS) Supplying Load.** This notice message indicates when the generator set supplies more than 1% of the rated standby output current.

**Engine Cooldown (Delay) Active.** This notice message indicates that the delay for engine cooldown is active where the generator set will continue to run after the OFF/RESET button is pressed. The unit will continue to run until the time delay times out.

**Engine Start Aid Active.** This notice message indicates that the start aid is active and will energize an engine equipped preheat or ether system during the crank cycle. Use SiteTech™ software to set up this feature.

**Engine Started.** This status indicates that the generator set start circuit is closed allowing the engine to crank and run.

**Engine Stopped.** This status indicates that the generator set start circuit is open causing the engine to shut down.

**Generator Running.** This notice indicates that the generator set has started and is running.

**Load Priority # Shed.** This status message indicates the digital output for load priority # (1, 2, 3, 4, 5, or 6) shed is active (contacts closed), indicating the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, or 6<sup>th</sup> priority load shed has been activated.

**Remote Start.** This notice indicates that the generator set start circuit was closed from a remote location allowing the engine to crank and run. The remote location is typically a set of contacts on a transfer switch or remote start switch.

**Remove Breaker Trip.** This notice message indicates that the controller considers the breaker to be safe to close. The breaker may be closed or preparing to close when this notice is displayed. This notice only appears in paralleling applications (where the bus sensing is connected to the bus side of the paralleling breaker).

**Run Button Acknowledged.** This notice message indicates that the RUN button on the controller has been pushed.

**System Ready.** This status indicates that the generator set is in the AUTO mode and available to start if the start circuit is closed.

### 2.6.6 Controller Resetting (Following System Shutdown or Warning)

Use the following procedure to restart the generator set after a system shutdown or to clear a warning lamp condition. This procedure includes the resetting of the optional remote annunciator.

Refer to Section 2.6.1, Emergency Stop, to reset the generator set after an emergency stop.

1. Disconnect the generator set load using the line circuit breaker or automatic transfer switch.
2. Correct the cause of the fault shutdown or warning. See the Safety Precautions and Instructions section of this manual before proceeding.
3. Start the generator set by pressing the generator set OFF/RESET button and then press the RUN button.

When equipped, the remote annunciator alarm horn sounds. Press the ALARM SILENCE/LAMP TEST button to stop the alarm horn. The lamp turns off.

4. Test operate the generator set to verify correction of the shutdown cause.
5. Press the generator set OFF/RESET button to stop the generator set.
6. Press the generator set AUTO button.
7. Silence the controller alarm horn by pressing the ALARM SILENCE button.
8. Reconnect the generator set load via the line circuit breaker or automatic transfer switch.
9. When equipped, the remote annunciator alarm horn sounds. Press the ALARM SILENCE/LAMP TEST button to stop the alarm horn. The lamp turns off.

## 2.7 Menu Displays

Use the Menu Summary List and Figure 2-10 after reading and understanding the features of the pushbutton/rotary selector dial. See Section 1.7.3, Digital Display.

The Menu Summary List and Figure 2-10 provide a quick reference to the digital display data. Some digital display data may not be identical to your display due to generator set application differences. The closed bullet items represent main level data and the open bullet items are sub-level data. The Menu Summary List indicates items that are user selectable. Use SiteTech™ software for changing programmable information.

# Menu Summary List (Legend: ● First level submenu, ○ second level submenu, ◇ third level submenu)

| Metering Menu  | Metering Menu (Continued)   | Generator Information Menu (Continued)   |
|--|---|--|
| <ul style="list-style-type: none"> <li>● <b>Generator Metering</b> <ul style="list-style-type: none"> <li>○ L1-L2 Volts: ###V</li> <li>○ L2-L3 Volts: ###V</li> <li>○ L3-L1 Volts: ###V</li> <li>○ AVG Gen Voltage L-L: ###V</li> <li>○ Gen Frequency: ##.Hz</li> <li>○ L1-L0 Volts: ###V</li> <li>○ L2-L0 Volts: ###V</li> <li>○ L3-L0 Volts: ###V</li> <li>○ AVG Gen Voltage L-N: ###V</li> <li>○ Gen Frequency: ##.Hz</li> <li>○ L1 Current: ###A</li> <li>○ L2 Current: ###A</li> <li>○ L3 Current: ###A</li> <li>○ AVG Current: ###A</li> <li>○ Gen Frequency: ##.Hz</li> <li>○ L1 Power: ####W</li> <li>○ L2 Power: ####W</li> <li>○ L3 Power: ####W</li> <li>○ Total Power: ####W</li> <li>○ Gen % of Rated kW: ###%</li> <li>○ L1 Reactive Power: ####VAR</li> <li>○ L2 Reactive Power: ####VAR</li> <li>○ L3 Reactive Power: ####VAR</li> <li>○ Total Reactive Power: ####VAR</li> <li>○ L1 Apparent Power: ####VA</li> <li>○ L2 Apparent Power: ####VA</li> <li>○ L3 Apparent Power: ####VA</li> <li>○ Total Apparent Power: ####VA</li> <li>○ Gen % of Rated kVA: ###%</li> <li>○ L1 PF: ##</li> <li>○ L2 PF: ##</li> <li>○ L3 PF: ##</li> <li>○ Total PF: ##</li> <li>○ Gen Phase Rotation: ###</li> </ul> </li> <li>● <b>Engine Metering</b> <ul style="list-style-type: none"> <li>○ Engine Speed: ####RPM</li> <li>○ Oil Pressure: ###PSI</li> <li>○ Coolant Temperature: ###°F</li> <li>○ Fuel Rate: ###GAL/h<br/>(shown if available from ECM)</li> <li>○ Gen Battery Voltage: ##.VDC</li> <li>○ ECM Battery Voltage: ##.VDC</li> <li>○ Oil Temperature: ###°F</li> <li>○ Coolant Pressure: ###PSI</li> <li>○ Fuel Pressure: ###PSI</li> <li>○ Fuel Temperature: ###°F</li> <li>○ Fuel Used Last Run: ###GAL<br/>(shown if available from ECM)</li> <li>○ Crankcase Pressure: ###PSI</li> <li>○ Intake Air Pressure: ###PSI</li> <li>○ Intake Air Temperature: ###°F</li> </ul> </li> <li>● <b>Overview</b> <ul style="list-style-type: none"> <li>○ Generator Status <ul style="list-style-type: none"> <li>◇ AVG Gen Voltage L-L: ###V</li> <li>◇ AVG Current: ###A</li> <li>◇ Gen Frequency: ##.Hz</li> </ul> </li> <li>○ Engine Status</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>◇ Coolant Temperature: ###°F</li> <li>◇ Oil Pressure: ###PSI</li> <li>◇ Gen Battery Voltage: ##.V</li> <li>○ System Status <ul style="list-style-type: none"> <li>◇ Fuel Pressure: ###PSI</li> <li>◇ Total Power: ####kW</li> <li>◇ Total Run Time: #####Hours</li> </ul> </li> <li>● <b>Paralleling Metering</b> <ul style="list-style-type: none"> <li>○ Connected to Bus: TRUE/FALSE</li> <li>○ AVG Bus Voltage L-L: ###.V</li> <li>○ AVG Gen Voltage L-L: ###.V</li> <li>○ Bus Frequency: ##.Hz</li> <li>○ Gen Frequency: ##.Hz</li> <li>○ Bus Total Power: #####kW</li> <li>○ Bus % of Rated kW: ###%</li> <li>○ Bus % of Rated kVAR: ###%</li> </ul> </li> </ul>   | <ul style="list-style-type: none"> <li>● <b>Configuration</b> <ul style="list-style-type: none"> <li>○ Generator Configuration <ul style="list-style-type: none"> <li>◇ Operating Mode: (Standby/Prime)</li> <li>◇ Application Type: (None/Marine/Mobile/Standby/Prime)</li> <li>◇ System Voltage L-L: ###V*</li> <li>◇ System Frequency: ##.Hz*</li> <li>◇ System Phase: (Single/Single Dog/Three-Wye/Three-Delta)*</li> <li>◇ Rated Engine Speed: ####RPM*</li> <li>◇ Engine Speed Adjustment: *</li> <li>◇ Adjusted Engine Run Speed: ####RPM</li> <li>◇ kW Rating: ####kW</li> <li>◇ kVA Rating: #####kVA</li> <li>◇ Rated Current: ###A</li> <li>◇ Battery Voltage: ##VDC*</li> <li>◇ Engine Start Delay: ##s*</li> <li>◇ Starting Aid Delay: ##s*</li> <li>◇ Crank On Delay: ##s*</li> <li>◇ Crank Pause Delay: ##s*</li> <li>◇ Engine Warmed Up: ###°F</li> <li>◇ Engine Cooled Down: ###°F</li> <li>◇ Cooldown Delay: ##s*</li> <li>◇ Cooldown Override: ON/OFF*</li> <li>◇ Fuel Type: (Natural Gas/LP/Gasoline/Diesel/Unknown)</li> <li>◇ Crank Cycles Limit: ##*</li> <li>◇ NFPA Defaults: ON/OFF*</li> <li>◇ Emergency Battlemode: ON/OFF*</li> </ul> </li> <li>○ Protection Configuration <ul style="list-style-type: none"> <li>◇ Overvoltage: ###%*</li> <li>◇ Overvoltage: ###.V</li> <li>◇ Overvoltage Delay: ##s*</li> <li>◇ Undervoltage: ###%*</li> <li>◇ Undervoltage: ##.V</li> <li>◇ Undervoltage Delay: ##s*</li> <li>◇ Overfrequency: ###%*</li> <li>◇ Overfrequency: ##.Hz</li> <li>◇ Underfrequency: ###%*</li> <li>◇ Underfrequency: ##.Hz</li> <li>◇ Overspeed: ##.Hz*</li> <li>◇ Overspeed: ##.Hz</li> <li>◇ Overspeed: ####RPM</li> <li>◇ Low Battery Voltage: ###%*</li> <li>◇ Low Battery Voltage: ##.VDC</li> <li>◇ High Battery Voltage: ###%*</li> <li>◇ High Battery Voltage: ##.VDC</li> </ul> </li> </ul> </li> <li>● <b>Voltage Regulation</b> <ul style="list-style-type: none"> <li>○ AVG Gen voltage L-L: ###.V</li> <li>○ Voltage Adjust: ###.V*</li> <li>○ Target Voltage: ###.V</li> <li>○ L1-L2 Volts: ###.V</li> <li>○ L2-L3 Volts: ###.V</li> <li>○ L3-L1 Volts: ###.V</li> <li>○ Gen Frequency: ##.Hz</li> <li>○ V/Hz Setpoint: ##.Hz*</li> <li>○ V/Hz Slope: ##%/Hz*</li> <li>○ Volt Droop at 100% kVAR: ##.##%*</li> <li>○ Voltage Gain Adjust: ###*</li> <li>○ Start Up Ramp Rate: ###%/s*</li> <li>○ Reset Regulator Defaults: YES/NO*</li> </ul> </li> </ul> |
|  | <b>Generator Information Menu</b> <ul style="list-style-type: none"> <li>● <b>Generator Information</b> <ul style="list-style-type: none"> <li>○ Total Run Time: #####hrs</li> <li>○ Hours Loaded: #####hrs</li> <li>○ Hours Unloaded: #####hrs</li> <li>○ kW Hours: #####kWh</li> <li>○ Operating Hours: #####hrs</li> <li>○ Total # of Starts: #####</li> <li>○ Last Maintenance: ##/##/####</li> <li>○ Op Hrs Since Maint: #####hrs</li> <li>○ Starts Since Maint: ###</li> <li>○ Eng Hrs Since Maint: #####hrs</li> <li>○ Loaded Since Maint: #####hrs</li> <li>○ Unloaded Since Maint: #####hrs</li> <li>○ kW Hrs Since Maint: #####kWh</li> <li>○ Reset Maint Records: YES/NO*</li> <li>○ Last Start: ##/##/####</li> <li>○ Last Run Length: #####hrs</li> <li>○ Controller Serial #: XXXXXXXXXX</li> <li>○ Software Version: XXXXXXXXXX</li> <li>○ ECM Serial #: XXXXXXXXXX</li> <li>○ Genset Model #: XXXXXXXXXX</li> <li>○ Genset Spec. #: XXXXXXXXXX</li> <li>○ Genset Serial #: XXXXXXXXXX</li> <li>○ Alternator Part #: XXXXXXXXXX</li> <li>○ Engine Part #: XXXXXXXXXX</li> <li>○ Engine Model #: XXXXXXXXXX</li> <li>○ Engine Serial #: XXXXXXXXXX</li> </ul> </li> <li>● <b>Event History</b> <ul style="list-style-type: none"> <li>○ Generator Event History<br/>##/##/#### (Date) ##.##.##XX (Time)<br/>Event: #####<br/>Parameter: #####<br/>FMI: #####<br/>Event X of Y</li> <li>○ Engine Event Log<br/>SPN: ####<br/>FMI: ##<br/>Occurrence Count: ###<br/>Event X of Y</li> </ul> </li> </ul> |  |

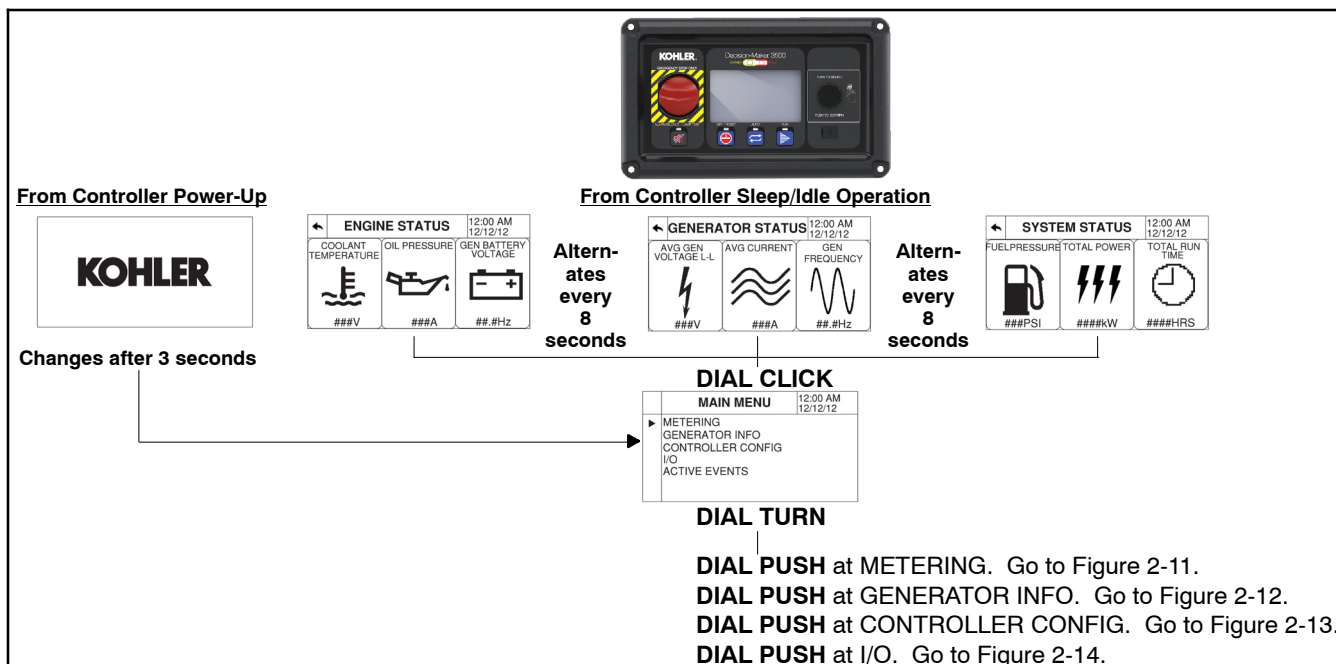
\* User-Defined (changeable) Menu Displays. Use SiteTech™ software to change other settings including User-Defined Menu Displays.

| Generator Information Menu (Continued)  | Generator Information Menu (Continued)   | Generator Information Menu (Continued)  |
|---|--|---|
| <ul style="list-style-type: none"> <li>● <b>Paralleling Operation</b> <ul style="list-style-type: none"> <li>○ Paralleling Setup <ul style="list-style-type: none"> <li>◇ Dead Bus Level: ##.##%</li> <li>◇ Voltage OK Pickup: ##.##%</li> <li>◇ Voltage OK Dropout: ##.##%</li> <li>◇ Frequency OK Pickup: ##.##Hz*</li> <li>◇ Frequency OK Dropout: ##.##Hz*</li> <li>◇ Volts-Hz OK Delay: ##.##s*</li> <li>◇ First On Delay: ##.##s*</li> <li>◇ Fail To Open Delay: ##s*</li> <li>◇ Fail To Close Delay: ##s*</li> <li>◇ Reclose Delay: ##.##s*</li> <li>◇ Max Close Attempts: ####</li> <li>◇ CB Current Fault Limit: ###.##%</li> <li>◇ CB Current Fault Delay: ##.##s*</li> <li>◇ CB Phase Fault Limit: ##.##°*</li> <li>◇ CB Phase Fault Delay: ##.##s*</li> <li>◇ kW Ramp Rate: ##.##%/s*</li> <li>◇ kW Disconnect Level: ##.##%</li> <li>◇ Trims Enable: ON/OFF*</li> <li>◇ Load Enable: ON/OFF*</li> <li>◇ System Load Control: ON/OFF*</li> <li>◇ System Sync Control: ON/OFF*</li> <li>◇ Stand Alone Mode: ON/OFF*</li> <li>◇ Sync Mode In Auto: (INVALID/OFF/PASSIVE/CHECK/ACTIVE/DEAD FIELD)*</li> <li>◇ Sync Mode In Run: (INVALID/OFF/PASSIVE/CHECK/ACTIVE/DEAD FIELD)*</li> </ul> </li> <li>○ Synchronizing Setup <ul style="list-style-type: none"> <li>◇ Sync Mode In Run: (INVALID/OFF/PASSIVE/CHECK/ACTIVE/DEAD FIELD)*</li> <li>◇ Sync Mode in Auto: (INVALID/OFF/PASSIVE/CHECK/ACTIVE/DEAD FIELD)*</li> <li>◇ Connected to Bus: TRUE/FALSE</li> <li>◇ Volts-Hz OK: TRUE/FALSE</li> <li>◇ In Sync: TRUE/FALSE</li> <li>◇ Voltage Matched: TRUE/FALSE</li> <li>◇ Voltage Match Window: ##.##%</li> <li>◇ AVG Bus Voltage L-L: ###.##V</li> <li>◇ AVG Gen Voltage L-L: ###.##V</li> <li>◇ Voltage Match P Gain: ##.##*</li> <li>◇ Voltage Match I Gain: ##.##*</li> <li>◇ Voltage Match D Gain: ##.##*</li> <li>◇ Voltage Bias: ###.##</li> <li>◇ Frequency Matched: TRUE/FALSE</li> <li>◇ Frequency Window: #.##Hz*</li> <li>◇ Bus Frequency: ##.##Hz</li> <li>◇ Gen Frequency: ##.##Hz</li> <li>◇ Freq Match P Gain: ##.##*</li> <li>◇ Freq Match I Gain: ##.##*</li> <li>◇ Freq Match D Gain: ##.##*</li> <li>◇ Speed Bias: ###.##</li> <li>◇ Phase Matched: TRUE/FALSE</li> <li>◇ Phase Match Window: ##.##°*</li> <li>◇ Phase Difference: ###.##°</li> <li>◇ Phase Match P Gain: ##.##*</li> <li>◇ Phase Match I Gain: ##.##*</li> <li>◇ Phase Match D Gain: ##.##*</li> <li>◇ Speed Bias: ###.##</li> <li>◇ Dwell Time: ##.##s*</li> <li>◇ Dwell Time Remaining: ##.##s</li> <li>◇ Fail to Sync Time: #####s*</li> <li>◇ Sync Time Remaining: #####s</li> </ul> </li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>◇ Bus Phase Rotation: DISABLED/A-B-C/C-B-A</li> <li>◇ Gen Phase Rotation: DISABLED/A-B-C/C-B-A</li> <li>○ Sharing Setup <ul style="list-style-type: none"> <li>◇ Bus % of Rated kW: ###.##%</li> <li>◇ Gen % of Rated kW: ###.##%</li> <li>◇ kW Sharing P Gain: ##.##*</li> <li>◇ kW Sharing I Gain: ##.##*</li> <li>◇ kW Sharing D Gain: ##.##*</li> <li>◇ Speed Bias: ###.##</li> <li>◇ System Frequency: ##.##Hz</li> <li>◇ Gen Frequency: ##.##Hz</li> <li>◇ Freq Trim P Gain: ##.##*</li> <li>◇ Freq Trim I Gain: ##.##*</li> <li>◇ Freq Trim D Gain: ##.##*</li> <li>◇ Speed Bias: ###.##</li> <li>◇ Freq Droop at 100% kW: ##.##%</li> <li>◇ Bus % of Rated kVAR: ###.##%</li> <li>◇ Gen % of Rated kVAR: ###.##%</li> <li>◇ kVAR Sharing P Gain: ##.##*</li> <li>◇ kVAR Sharing I Gain: ##.##*</li> <li>◇ kVAR Sharing D Gain: ##.##*</li> <li>◇ Voltage Bias: ###.##</li> <li>◇ System Voltage L-L: ###.##V</li> <li>◇ AVG Gen Voltage L-L: ###.##V</li> <li>◇ Volt Trim P Gain: ##.##*</li> <li>◇ Volt Trim I Gain: ##.##*</li> <li>◇ Volt Trim D Gain: ##.##*</li> <li>◇ Voltage Bias: ###.##</li> <li>◇ Volt Droop at 100% kVAR: ##.##%</li> </ul> </li> <li>○ Protective Relay Setup <ul style="list-style-type: none"> <li>◇ Over Power Trip: ###.##%</li> <li>◇ Over Power Delay: ##.##s*</li> <li>◇ Reverse Power Trip: ###.##%</li> <li>◇ Reverse Power Delay: ##.##s*</li> <li>◇ Over Voltage Trip: ###.##%</li> <li>◇ Over Voltage Delay: ##.##s*</li> <li>◇ Under Voltage Trip: ###.##%</li> <li>◇ Under Voltage Delay: ##.##s*</li> <li>◇ Over Freq Trip: ###.##%</li> <li>◇ Over Freq Delay: ##.##s*</li> <li>◇ Under Freq Trip: ###.##%</li> <li>◇ Under Freq Delay: ##.##s*</li> <li>◇ Reverse VAR Trip: ###.##%</li> <li>◇ Reverse VAR Delay: ##.##s*</li> <li>◇ Over Current Trip: ###.##%</li> <li>◇ Over Current Delay: ##.##s*</li> <li>◇ Trip To Shtdwn Delay: #####s*</li> </ul> </li> <li>○ Generator Management <ul style="list-style-type: none"> <li>◇ Gen Management Mode: (INVALID/MANUAL FIXED/RUN TIME/FUEL LEVEL)*</li> <li>◇ Gen Management: ON/OFF*</li> <li>◇ Gen Management Order: #*<br/><i>will revert to previous setting in run time or fuel level mode.</i></li> <li>◇ Start Capacity: ###.##%</li> <li>◇ Start Delay: #####s*</li> <li>◇ Stop Capacity: ###.##%</li> <li>◇ Stop Delay: #####s*</li> <li>◇ Total Bus Capacity: #####kW</li> <li>◇ Bus Total Power: #####kW</li> <li>◇ Start kW: #####kW</li> <li>◇ Stop kW: #####kW</li> <li>◇ Start Accumulator: #####</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>◇ Stop Accumulator: #####</li> <li>◇ Run Time Threshold: ###.##hrs*<br/><i>only if in Run Time Management</i></li> <li>◇ Total Run Time: #####hrs</li> <li>◇ Fuel Level Threshold: ##.##%*<br/><i>only if in Fuel Level Management</i></li> <li>◇ Fuel Level: ###.##%</li> <li>◇ Stable Delay: #####s*</li> <li>◇ Minimum Gens Online: ##*</li> <li>◇ Min Loads Added: ##*</li> <li>◇ Stopped By Gen Mgmt: TRUE/FALSE</li> <li>○ Load Control <ul style="list-style-type: none"> <li>◇ Gen Max % Cap: ###.##%</li> <li>◇ Gen Overload %: ###.##%</li> </ul> </li> </ul>  |
|   |  | <b>Controller Configuration Menu</b> <ul style="list-style-type: none"> <li>● <b>Controller Configuration</b> <ul style="list-style-type: none"> <li>○ Language: English*</li> <li>○ Units: Metric/English*</li> <li>○ Time Format: Hr 12/Hr 24*</li> <li>○ Date Format: Month Date Year/Date Month Year*</li> <li>○ Date: ##/##/####*</li> <li>○ Time: ##:## XM*</li> <li>○ Contrast: ###*</li> <li>○ Alarm Silence: ALWAYS/AUTO ONLY*</li> </ul> </li> <li>● <b>Communication Setup</b> <ul style="list-style-type: none"> <li>○ Modbus Baud Rate: OFF/9600 b/s/19200 b/s/38400 b/s/57600 b/s/115200 b/s*</li> <li>○ Modbus Address: ##*</li> <li>○ PGEN Baud Rate: OFF/9600 b/s/19200 b/s/38400 b/s/57600 b/s/115200 b/s</li> <li>○ PGEN Node ID: ##</li> <li>○ PGEN Nodes Online: ##</li> <li>○ PGEN Nodes Offline: ##</li> </ul> </li> <li>● <b>Calibration</b><br/><i>When the line is highlighted, hold the knob down to enable the calibration capability.</i> <ul style="list-style-type: none"> <li>○ Gen L1-L0 Volts: ###.##V*</li> <li>○ Gen L2-L0 Volts: ###.##V*</li> <li>○ Gen L3-L0 Volts: ###.##V*</li> <li>○ Gen L1-L2 Volts: ###.##V*</li> <li>○ Gen L2-L3 Volts: ###.##V*</li> <li>○ Gen L3-L1 Volts: ###.##V*</li> <li>○ Gen L1 Current: ###.##A*</li> <li>○ Gen L2 Current: ###.##A*</li> <li>○ Gen L3 Current: ###.##A*</li> <li>○ Bus L1-L2 Volts: ###.##V*</li> <li>○ Bus L2-L3 Volts: ###.##V*</li> <li>○ Bus L3-L1 Volts: ###.##V*</li> <li>○ Reset Gen Volt Meter: YES/NO*</li> <li>○ Reset Gen Amp Meter: YES/NO*</li> <li>○ Reset Bus Volt Meter: YES/NO*</li> <li>○ Reset All Meters: YES/NO*</li> </ul> </li> </ul> |

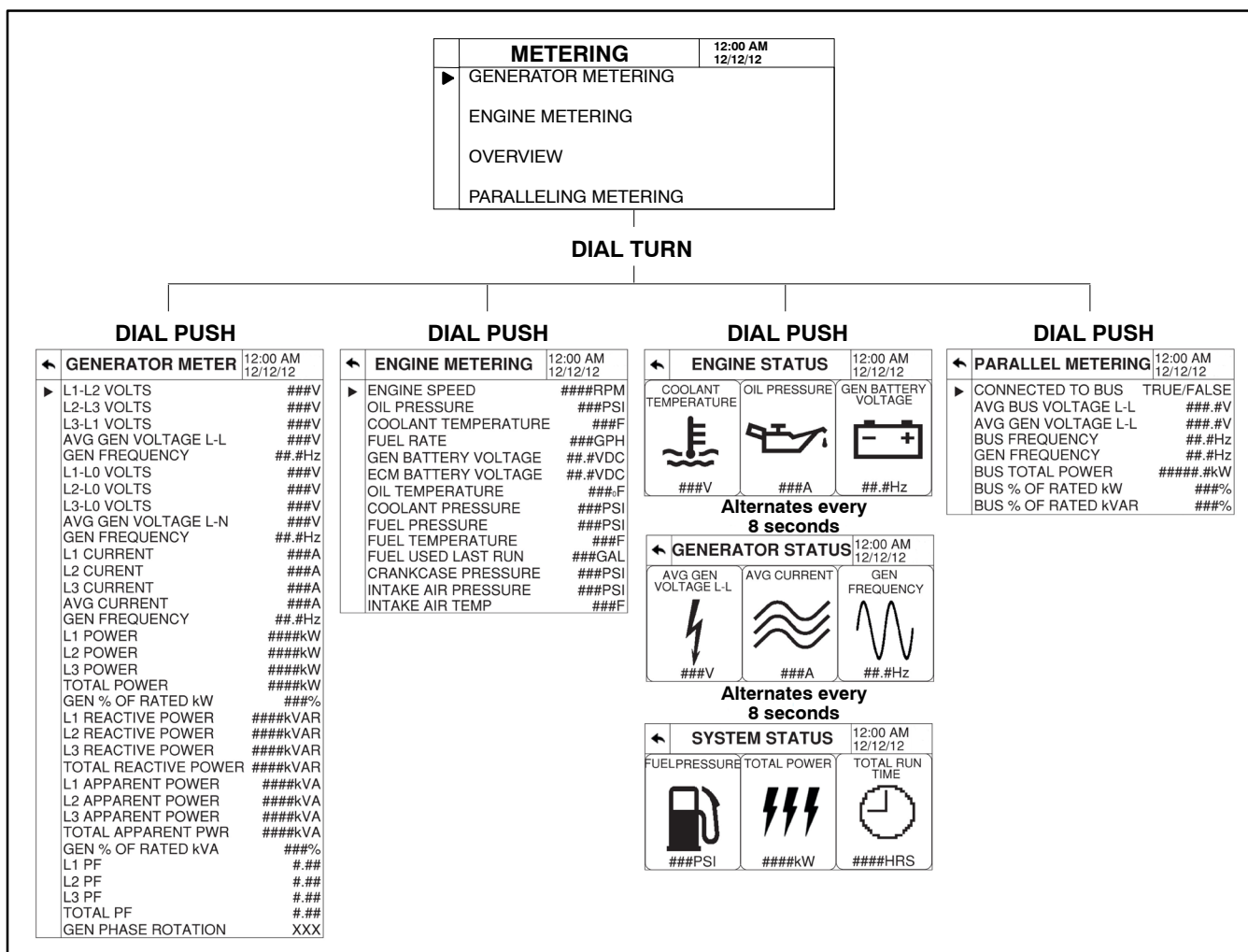
\* User-Defined (changeable) Menu Displays. Use SiteTech™ software to change other settings including User-Defined Menu Displays.

| I/O Menu   | I/O Menu (Continued)  | Active Events Menu   |
|--|---|--|
| <ul style="list-style-type: none"> <li>● <b>Resistive Input</b></li> <li>Analog Input 0:1</li> <li>Analog Input 0:2</li> <li>Analog Input 0:3</li> <li>Analog Input 0:4</li> <li>Analog Input 0:5</li> <li>Analog Input 0:6               <ul style="list-style-type: none"> <li>○ Description: <i>(function by default unless modified via SiteTech)</i></li> <li>○ Measurement: ###.##Ohms</li> <li>○ Shutdown: *</li> <li>○ Input Enabled: ON/OFF*</li> <li>○ Sensor Type: *</li> <li>○ Warning: ON/OFF*</li> <li>○ Low Protective Inhibit: ##s*</li> <li>○ Low Warning: ON/OFF*</li> <li>○ Low Warning Limit: *</li> <li>○ Low Warning Delay: ##s*</li> <li>○ Low Shutdown: ON/OFF*</li> <li>○ Low Shutdown Limit: *</li> <li>○ Low Shutdown Delay: ##s*</li> <li>○ High Protective Inhibit: ##s*</li> <li>○ High Warning: ON/OFF*</li> <li>○ High Warning Limit: *</li> <li>○ High Warning Delay: ##s*</li> <li>○ High Shutdown: ON/OFF*</li> <li>○ High Shutdown Limit: *</li> <li>○ High Shutdown Delay: ##s*</li> <li>○ I/O Board Number: X</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>● <b>Digital Input</b></li> <li>Digital Input 0:1</li> <li>Digital Input 0:2</li> <li>Digital Input 0:3</li> <li>Digital Input 0:4</li> <li>Digital Input 0:5</li> <li>Digital Input 0:6               <ul style="list-style-type: none"> <li>○ Description: <i>(function by default unless modified via SiteTech)</i></li> <li>○ Status: ACTIVE/INACTIVE</li> <li>○ Function: *</li> <li>○ Event: *</li> <li>○ Enabled: ON/OFF*</li> <li>○ Inhibit Time: ##s*</li> <li>○ Delay Time: ##s*</li> <li>○ I/O Board Number: X</li> </ul> </li> <li>● <b>Digital Output</b></li> <li>Digital Output 0:1</li> <li>Digital Output 0:2</li> <li>Digital Output 0:3</li> <li>Digital Output 0:4</li> <li>Digital Output 1:1</li> <li><i>(Note: Only displayed if the 15-Relay Dry Contact Kit is installed.)</i></li> <li>...</li> <li> <ul style="list-style-type: none"> <li>○ Description: <i>(function by default unless modified via SiteTech)</i></li> <li>○ Status: ACTIVE/INACTIVE</li> <li>○ Function: *</li> <li>○ Event: *</li> <li>○ Logic: ACTIVE ON/ACTIVE OFF*</li> <li>○ I/O Board Number: X</li> </ul> </li> </ul> | <p>Rotate the dial to view Active Events:</p> <p>Warnings</p> <p>Shutdowns</p> <p>Statuses</p> <p>Notices</p> <p>See Section 2.6.3, Section 2.6.4, and Section 2.6.5 for descriptions.</p> <p>Press the OFF button to return to the main menu.</p> |

\* User-Defined (changeable) Menu Displays. Use SiteTech™ software to change other settings including User-Defined Menu Displays.



**Figure 2-10** Decision-Maker 3500 Controller Information Menu Structure



**Figure 2-11** Metering Menu



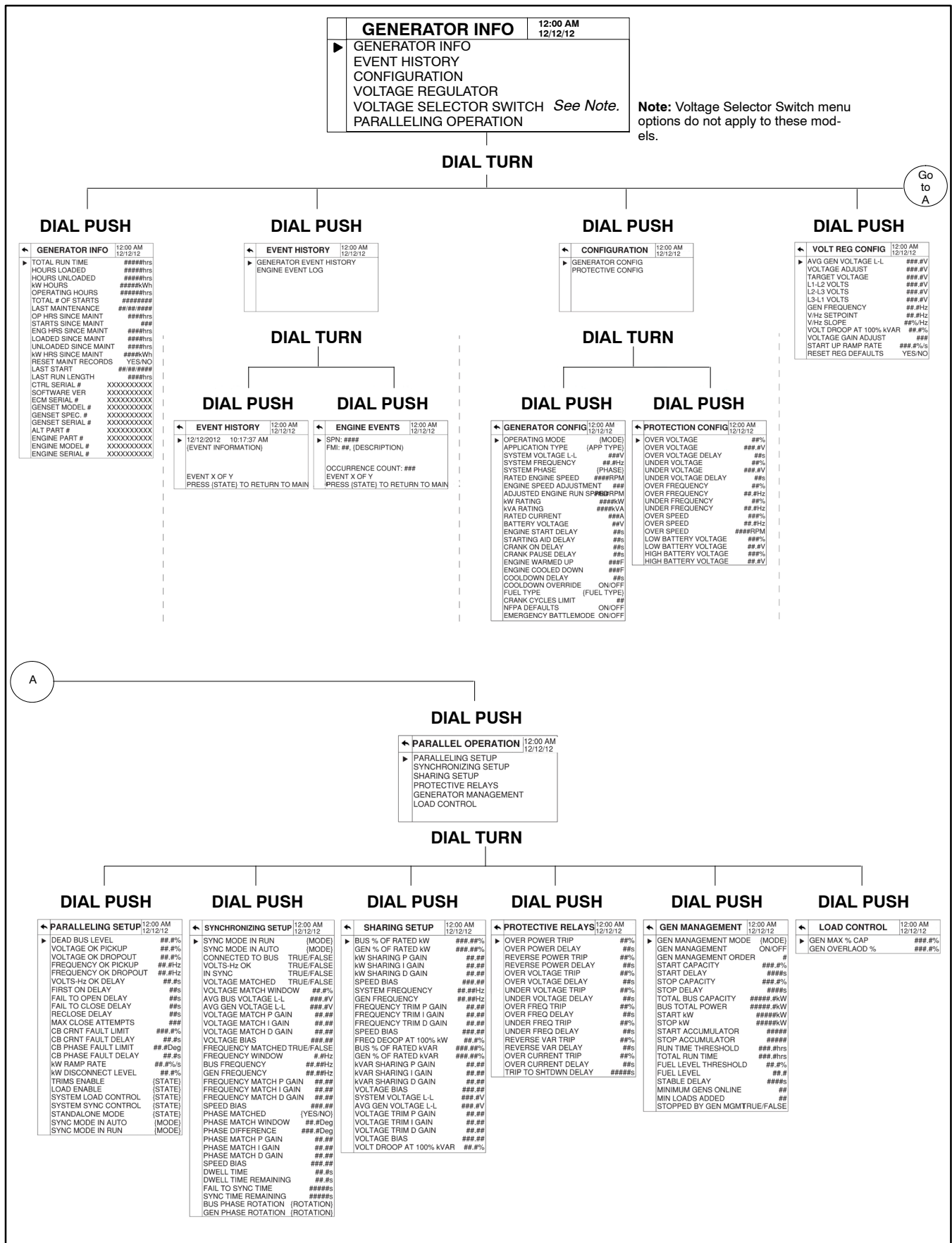
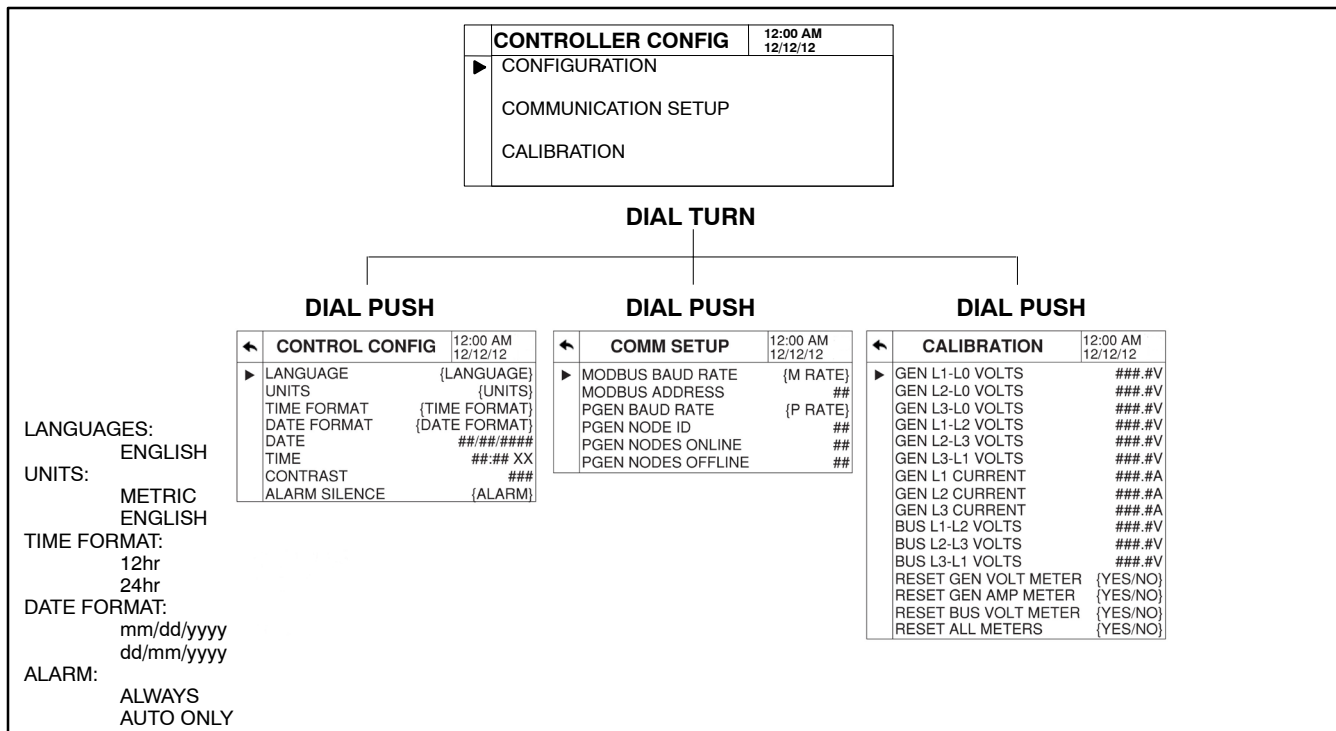
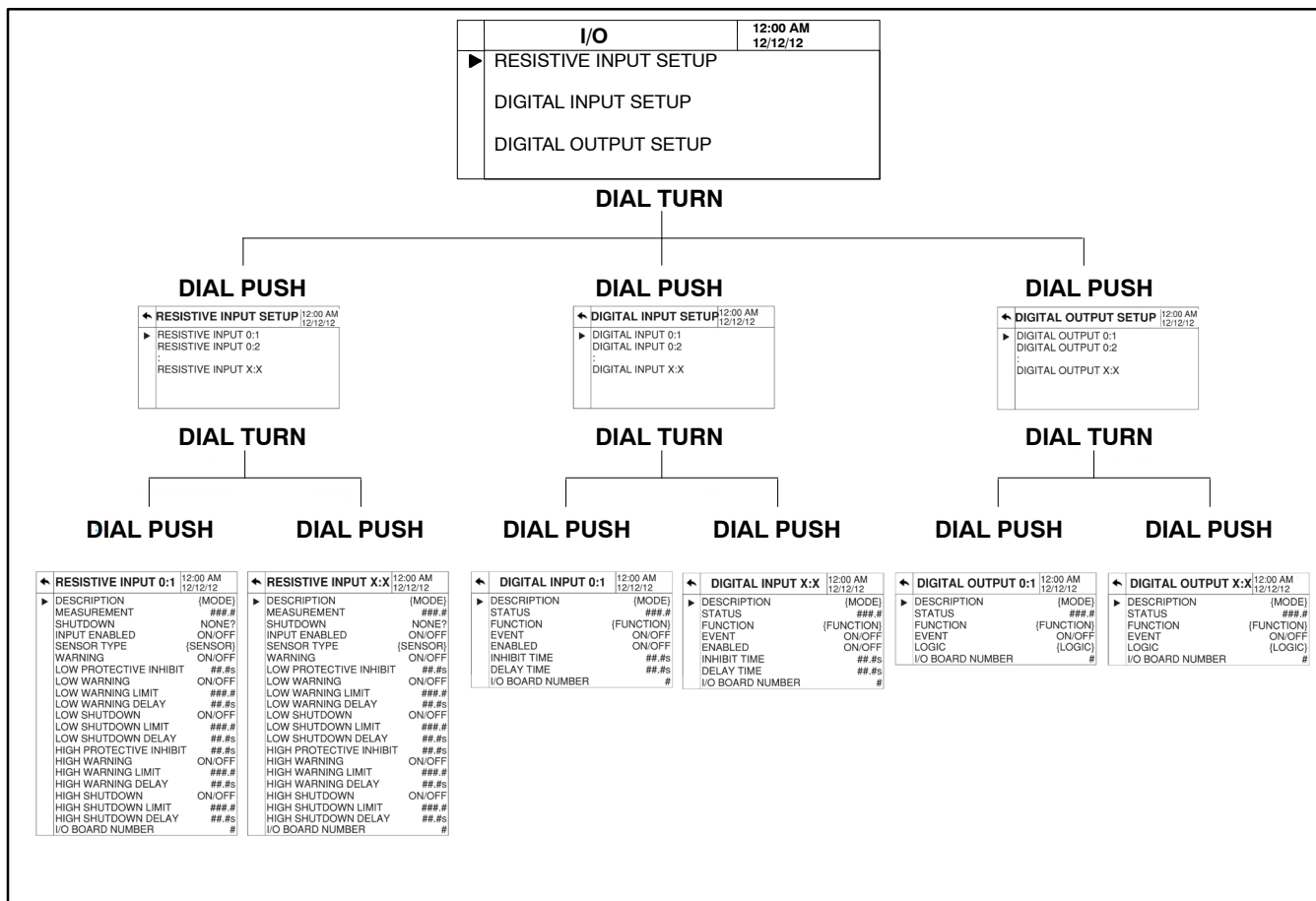


Figure 2-12 Generator Information Menu



**Figure 2-13** Controller Configuration Menu



**Figure 2-14** I/O Menu

## 2.8 Monitoring and Programming Setup

The user programmer can access the controller data with the controller digital display or a personal computer (PC) with optional SiteTech™ software to monitor and/or program. Access the controller system with a PC using a USB cable with a mini USB plug. Refer to the Introduction, List of Related Materials for related software literature.

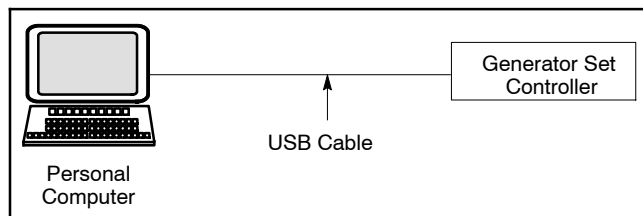
While this manual focuses on data access through the controller pushbutton/rotary selector dial and display, most data entries require input using a PC for initial setup. The PC entries typically include alpha characters such as digital input descriptions.

### 2.8.1 PC Communications

Communicate between a PC and the generator set controller logic using USB communication protocol. The PC connections require optional SiteTech™ software. Contact your authorized distributor/dealer for assistance.

#### Local Single Connection

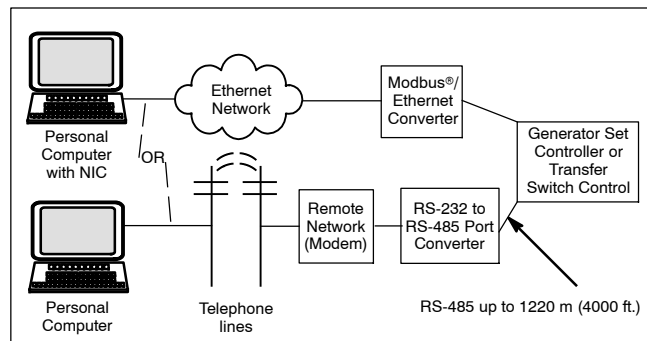
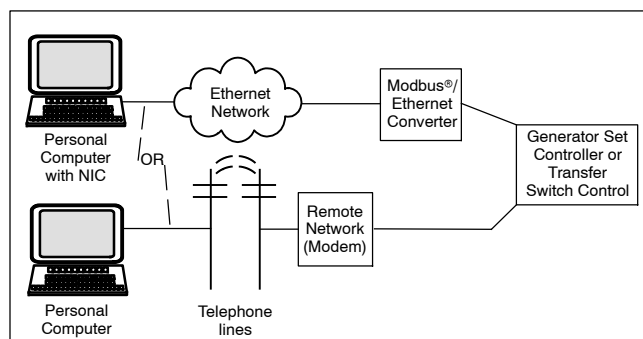
A PC connects to the USB port of the generator set controller using a mini USB connector. See Figure 2-15.



**Figure 2-15** Local Single Connection

#### Remote Single Connection

A modem connects a PC to a single device. The PC communicates with the device via telephone line or an ethernet network. See Figure 2-16.

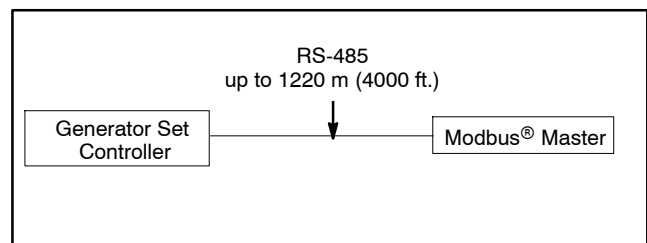


**Figure 2-16** Remote Single Connections

### 2.8.2 Modbus® Communications

The controller communicates using Modbus® as a slave connection with the Modbus® master initiating the communication. The controller seeks the system and alternator parameters and diagnostic information then responds back to the Modbus® master. In addition, the controller accepts information to alter controller parameters including generator set starting and stopping. See Figure 2-17. Refer to the List of Related Materials for available Modbus® literature.

**Note:** Only one Modbus® master can be connected to the controller. Examples include the remote serial annunciator, Monitor III, and switchgear applications.



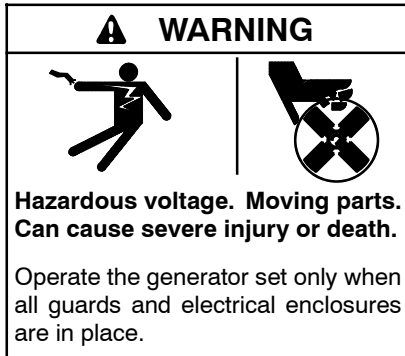
**Figure 2-17** Modbus® Connections

## Notes

## Section 3 Scheduled Maintenance

Under normal operating conditions, the generator set's alternator requires no routine service. Consult Section 2.1, Prestart Checklist, for a list of routine checks.

### 3.1 Alternator Service

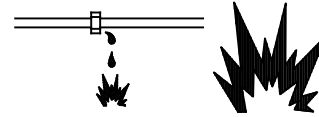


**Servicing the generator set when it is operating. Exposed moving parts can cause severe injury or death.** Keep hands, feet, hair, clothing, and test leads away from the belts and pulleys when the generator set is running. Replace guards, screens, and covers before operating the generator set.

When operating the generator set under dusty or dirty conditions, use dry compressed air to blow dust out of the alternator while the generator set is running. Direct the stream of air through openings in the generator set end bracket.

### 3.2 Engine Service

#### ⚠ WARNING

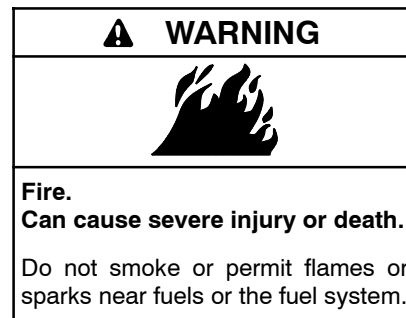


**Explosive fuel vapors.  
Can cause severe injury or death.**

Use extreme care when handling, storing, and using fuels.

**The fuel system. Explosive fuel vapors can cause severe injury or death.** Vaporized fuels are highly explosive. Use extreme care when handling and storing fuels. Store fuels in a well-ventilated area away from spark-producing equipment and out of the reach of children. Never add fuel to the tank while the engine is running because spilled fuel may ignite on contact with hot parts or from sparks. Do not smoke or permit flames or sparks to occur near sources of spilled fuel or fuel vapors. Keep the fuel lines and connections tight and in good condition. Do not replace flexible fuel lines with rigid lines. Use flexible sections to avoid fuel line breakage caused by vibration. Do not operate the generator set in the presence of fuel leaks, fuel accumulation, or sparks. Repair fuel systems before resuming generator set operation.

**Draining the fuel system. Explosive fuel vapors can cause severe injury or death.** Spilled fuel can cause an explosion. Use a container to catch fuel when draining the fuel system. Wipe up spilled fuel after draining the system.



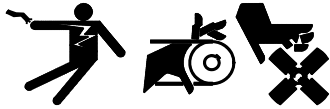
**Servicing the air cleaner. A sudden backfire can cause severe injury or death.** Do not operate the generator set with the air cleaner/silencer removed.

#### NOTICE

**Saltwater damage.** Saltwater quickly deteriorates metals. Wipe up saltwater on and around the generator set and remove salt deposits from metal surfaces.

---

**⚠ WARNING**



**Accidental starting.  
Can cause severe injury or death.**

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

---

**Disabling the generator set. Accidental starting can cause severe injury or death.** Before working on the generator set or equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

**⚠ WARNING**



**Hot engine and exhaust system.  
Can cause severe injury or death.**

Do not work on the generator set until it cools.

**Servicing the exhaust system. Hot parts can cause severe injury or death.** Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.

**⚠ WARNING**



**Hazardous voltage. Moving parts.  
Can cause severe injury or death.**

Operate the generator set only when all guards and electrical enclosures are in place.

**Servicing the generator set when it is operating. Exposed moving parts can cause severe injury or death.** Keep hands, feet, hair, clothing, and test leads away from the belts and pulleys when the generator set is running. Replace guards, screens, and covers before operating the generator set.

**Grounding electrical equipment. Hazardous voltage can cause severe injury or death.** Electrocuting is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

**Disconnecting the electrical load. Hazardous voltage can cause severe injury or death.** Disconnect the generator set from the load by turning off the line circuit breaker or by disconnecting the generator set output leads from the transfer switch and heavily taping the ends of the leads. High voltage transferred to the load during testing may cause personal injury and equipment damage. Do not use the safeguard circuit breaker in place of the line circuit breaker. The safeguard circuit breaker does not disconnect the generator set from the load.

Perform engine service at the intervals specified in the engine manufacturer's service literature. Contact an authorized service distributor/dealer to obtain service literature.

**Note:** Have maintenance work, including battery service, performed by appropriately skilled and suitably trained maintenance personnel familiar with generator set operation and service.

See the Safety Precautions and Instructions at the beginning of this manual before attempting to service, repair, or operate the generator set. Have an authorized distributor/dealer perform generator set service.

**Routine Maintenance.** Refer to the following generator set service schedule, the engine service schedule, and the hourmeter located on the generator set controller to determine when to schedule routine maintenance. Service more frequently generator sets that are subject to extreme weather or dusty or dirty conditions.

**Service Log.** Use the Operating Hour Service Log located in the back of this manual to document performed services.

**Service Schedule.** Perform maintenance on each item in the service schedule at the designated intervals for the life of the generator set. For example, an item requiring service every 100 hours or 3 months also requires service after 200 hours or 6 months, 300 hours or 9 months, and so on.

### 3.3 Generator Set Service Schedule

**Note:** Have maintenance work, including battery service, performed by appropriately skilled and

suitably trained maintenance personnel familiar with generator set operation and service.

| System—Component   | Action           |       |        |       |      | Interval   |
|--|------------------|-------|--------|-------|------|--|
|  | Visually Inspect | Check | Change | Clean | Test |  |
| Fuel System  |                  |       |        |       |      |  |
| Drain water from fuel filter   |                  | ●     |        | ●     |      | Before operation                                     |
| Flexible lines and connections   | X                |       | R      |       |      | Weekly   |
| Solenoid valve operation   | X                |       |        |       | X    | Weekly   |
| Transfer pump operation  | X                |       |        |       | X    | Weekly   |
| Replace fuel filter elements   |                  |       | ●      |       |      | Yearly or 500 Hrs.                                   |
| Fuel piping  | X                |       |        |       |      | Yearly   |
| Return lines for obstructions  |                  | X     |        |       |      | Yearly   |
| Bleed fuel system  |                  | R     |        |       |      | As required  |
| Lubrication System   |                  |       |        |       |      |  |
| Check oil level  | ●                | ●     |        |       |      | Before operation                                     |
| Change oil   |                  |       | ●      |       |      | First 50 Hrs., Then<br>Every 250 Hrs. or<br>6 months |
| Replace filter(s)*   |                  |       | ●      |       |      |  |
| Crankcase breather   | ●                |       | ●      |       |      | Quarterly  |
| Replace crankcase vent filter, if equipped   |                  |       | ●      |       |      | Yearly or 500 Hrs.                                   |
| Clean crankcase ventilation system, if equipped  |                  |       | ●      |       |      | Yearly or 500 Hrs.                                   |
| Cooling System   |                  |       |        |       |      |  |
| Check the seawater outlet and clean as necessary   |                  | X     |        | X     |      | Daily  |
| Check coolant level  | ●                | ●     |        |       |      | Before operation                                     |
| Check seawater strainer  | ●                | ●     |        |       |      | Before operation                                     |
| Block heater operation, if equipped  |                  | X     |        |       |      | Weekly   |
| Flexible hoses and connectors  | X                | X     |        |       |      | Weekly   |
| Water pump(s)  | ●                |       |        |       |      | Weekly   |
| Check the function of the siphon break, if equipped  |                  | X     |        |       |      | 3 Months or 100 Hrs.                                 |
| Inspect and replace zinc plugs   |                  | ●     | ●      |       |      | 6 Months or 250 Hrs.                                 |
| Check the seawater pump impeller   |                  | X     |        |       |      | 6 Months or 250 Hrs.                                 |
| Coolant temperature protection level   |                  |       |        |       | ●    | 6 Months or 250 Hrs.                                 |
| Check cooling system   | ●                | ●     |        |       |      | Yearly or 500 Hrs.                                   |
| Inspect and clean heat exchanger core and aftercooler core, if equipped  |                  | ●     |        | ●     |      | Yearly or 500 Hrs.                                   |
| Replace the seawater pump impeller   |                  |       | R      |       |      | Yearly or 500 Hrs.                                   |
| Pressure test cooling system   |                  |       |        |       | ●    | 2 years or 2000 Hrs.                                 |
| Test thermostats   |                  |       |        |       | ●    | 2 years or 2000 Hrs.                                 |
| Flush and refill cooling system  |                  |       | ●      |       |      | 2 years or 2000 Hrs.                                 |
| Inspect and repair seawater pump   | ●                | ●     |        |       |      | 2 years or 2000 Hrs.                                 |
| Add coolant  | ●                | R     |        |       |      | As required  |
| Exhaust System   |                  |       |        |       |      |  |
| Inspect the exhaust system components  |                  | X     |        |       |      | Before operation                                     |
| Check the exhaust gas condition. If the exhaust is blue or black, contact your local distributor/dealer  | X                |       |        |       |      | During operation                                     |
| Clean the exhaust/water mixing elbow   |                  |       |        | X     |      | 6 Months or 250 Hrs.                                 |
| Inspect the complete exhaust system ‡  |                  | X     |        |       |      | Yearly or 500 Hrs.                                   |
| Excessive back pressure  |                  |       |        |       | X    | Yearly   |
| Hangers and supports   | X                |       |        |       |      | Yearly   |
| <div>● Follow procedures and frequencies indicated in the engine manufacturer's maintenance manual.<br/>If not indicated, follow this service schedule. Some items may not apply to all generator sets.</div> <div>R Replace as necessary.</div> <div>X Action</div> <div>* Service more frequently if operated in dusty areas.</div> <div>‡ Should be performed by your local distributor/dealer.</div> <div>§ Consult the battery manufacturer's instructions.</div> |                  |       |        |       |      |  |

## Service Schedule, continued

| System—Component  | Action           |       |        |       |      | Interval             |
|---|------------------|-------|--------|-------|------|----------------------|
|   | Visually Inspect | Check | Change | Clean | Test |                      |
| DC Electrical System  |                  |       |        |       |      |                      |
| Keep the battery charged and in good condition §  |                  | X     |        |       |      | Before operation     |
| Check and tighten the electrical connections  |                  | X     |        |       |      | Monthly or 50 Hrs.   |
| Clean the battery cables  |                  |       |        | X     |      | Yearly or 500 Hrs.   |
| AC Electrical System  |                  |       |        |       |      |                      |
| Controller lamp test  | X                |       |        |       | R    | Weekly               |
| General Inspection  | X                |       |        |       |      | Weekly               |
| Circuit breakers, fuses†  | X                | X     | R      | X     | X    | Monthly              |
| Wire abrasions where subject to motion  | X                | X     |        |       |      | Quarterly            |
| Safety and alarm operation  |                  | X     |        |       | X    | 6 Months             |
| Tighten control and power wiring connections  |                  | X     |        |       |      | Yearly               |
| Transfer switch main contacts†  | X                |       |        | X     |      | Yearly               |
| Voltage-sensing device/relay adjustment†  |                  | ●     |        |       | ●    | Yearly               |
| Wire-cable insulation breakdown   | X                |       |        |       | X    | 3 Years              |
| Engine and Mounting   |                  |       |        |       |      |                      |
| Check air cleaner dust unloader valve   | ●                | ●     |        |       |      | Before operation     |
| General inspection  | ●                |       |        |       |      | Before operation     |
| Governor operation, lubricate moving parts (33–40 kW)   | ●                | ●     |        |       |      | Monthly              |
| Check belt  | ●                | ●     | R      |       |      | Monthly              |
| Check engine mounts   | ●                | ●     |        |       |      | 6 Months or 250 Hrs. |
| Inspect the air cleaner element and clean or replace as necessary   |                  | ●     | ●      |       |      | 6 Months or 250 Hrs. |
| Check air intake hoses, connections, and system   | ●                | ●     |        |       |      | Yearly or 500 Hrs.   |
| Check engine speeds   |                  | ●     |        |       |      | Yearly or 500 Hrs.   |
| Check engine electrical ground  |                  | ●     |        |       |      | Yearly or 500 Hrs.   |
| Governor oil (mechanical governor only) (33–40 kW)  |                  | ●     |        |       |      | Yearly               |
| Ignition components   | ●                |       |        | ●     |      | Yearly               |
| Injector pump & injector flow rate, pressure, spray pattern   |                  | ●     |        |       | ●    | Yearly               |
| Check and adjust valve clearance  |                  | ●     | ●      |       |      | 2 Years or 2000 Hrs. |
| Check crankshaft vibration damper (100–150 kW)  |                  | ●     |        |       |      | 2 Years or 2000 Hrs. |
| Bolt torque   |                  | ●     |        |       | ●    | 3 Years              |
| Check front PTO, if equipped  | ●                | ●     |        |       |      | As required          |
| Remote Control System, etc.   |                  |       |        |       |      |                      |
| Compartment condition   | X                |       |        | X     |      | Weekly               |
| Remote control  |                  |       |        |       | X    | Monthly              |
| Run generator set   |                  |       |        |       | X    | Monthly              |
| Alternator  |                  |       |        |       |      |                      |
| Rotor and stator  | X                |       |        | X     |      | Yearly               |
| Bearing condition   | X                | X     | R      |       |      | Yearly               |
| Exciter   | X                | X     |        | X     |      | Yearly               |
| Voltage regulator   | X                | X     |        | X     |      | Yearly               |
| Measure and record resistance readings of windings with insulation tester (Megger®, with SCR assembly or rectifier disconnected)  |                  |       |        |       | X    | Yearly               |
| Blow dust out of alternator*  | X                |       |        | ●     |      | 2 Years              |
| General Condition of Equipment  |                  |       |        |       |      |                      |
| Visual walkaround general inspection  | X                |       |        |       |      | Before operation     |
| Any condition of vibration, leakage, noise, temperature, or deterioration   | X                | X     |        | X     |      | Weekly               |
| ● Follow procedures and frequencies indicated in the engine manufacturer’s maintenance manual. If not indicated, follow this service schedule. Some items may not apply to all generator sets.<br>R Replace as necessary.<br>X Action.<br>* Service more frequently if operated in dusty areas.<br>† Do not break manufacturer’s seals or internally inspect these devices. |                  |       |        |       |      |                      |

Megger® is a registered trademark of Biddle Instruments.



## 3.4 Alternator Bearing Service

Have an authorized service distributor/dealer perform service.

### 3.4.1 20–300 kW Models

Replace the end bracket bearing every 10,000 hours of operation in prime power applications. Service the bearing more frequently if the annual inspection indicates excessive rotor end play or bearing damage. The sealed end bracket bearing requires no additional lubrication.

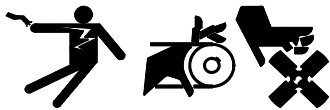
## 3.5 Diesel Fuel Systems

### 3.5.1 Bleeding Air from Fuel System

Bleed air from the fuel system after fuel system maintenance, such as replacing the fuel filter(s). Use the information provided in the engine operation manual.

## 3.6 Cooling System

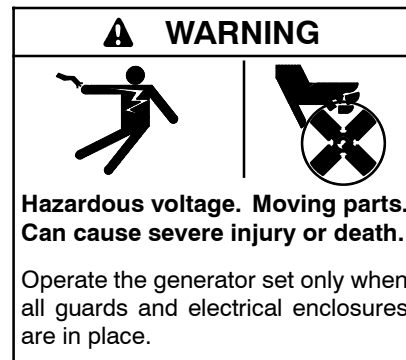
### ⚠ WARNING



**Accidental starting.  
Can cause severe injury or death.**

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

**Disabling the generator set. Accidental starting can cause severe injury or death.** Before working on the generator set or equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.



**Hazardous voltage. Moving parts.  
Can cause severe injury or death.**

Operate the generator set only when all guards and electrical enclosures are in place.

**Disconnecting the electrical load. Hazardous voltage can cause severe injury or death.** Disconnect the generator set from the load by turning off the line circuit breaker or by disconnecting the generator set output leads from the transfer switch and heavily taping the ends of the leads. High voltage transferred to the load during testing may cause personal injury and equipment damage. Do not use the safeguard circuit breaker in place of the line circuit breaker. The safeguard circuit breaker does not disconnect the generator set from the load.

**Grounding electrical equipment. Hazardous voltage can cause severe injury or death.** Electrocutation is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

### ⚠ WARNING



**Hot coolant and steam.  
Can cause severe injury or death.**

Before removing the pressure cap, stop the generator set and allow it to cool. Then loosen the pressure cap to relieve pressure.

Allow the engine to cool. Release pressure from the cooling system before removing the pressure cap. To release pressure, cover the pressure cap with a thick cloth and then slowly turn the cap counterclockwise to the first stop. Remove the cap after pressure has been completely released and the engine has cooled. Check the coolant level at the tank if the generator set has a coolant recovery tank.

### 3.6.1 Cooling System Component Inspection

To prevent generator set shutdown or damage caused by overheating:

- Keep the cooling air inlets clean and unobstructed.
- Inspect the radiator's exterior for obstructions. Remove dirt and foreign material using a soft brush or cloth to avoid damaging the radiator fins.
- Check the hoses and connections for leaks. Replace any cracked, frayed, or spongy hoses.
- Check the condition and tension of the radiator fan and water pump belt(s). Follow the belt tension procedure in this manual and/or the engine operation manual.
- Check the pressure cap seal and replace a cracked or deteriorated cap. Remove dirt and other debris from the pressure cap and filler neck. The pressure cap raises the boiling point of the coolant, enabling higher operating temperatures. Replace a leaking pressure cap with one rated for the same pressure. The pressure cap rating usually appears on the pressure cap.

### 3.6.2 Procedure to Drain Cooling System

For optimum protection, drain, flush, and refill the cooling system at the intervals listed in the service schedule.

**Note:** Dispose of all waste materials (oil, fuel, coolant, filters, and gaskets) in an environmentally safe manner.

1. Deenergize the block heater, if equipped.
2. Remove the pressure cap to allow the entire system to drain and prevent air pockets from restricting coolant flow through the engine block.
3. Open the radiator and/or engine block coolant drain valve(s) and allow the system to drain.
4. If the inside of the radiator has mineral deposits or the used coolant contains dirt or grease, refer to Section 3.6.3, Procedure to Flush and Clean the Cooling System. If the cooling system does not have mineral deposits, go to Section 3.6.4, Procedure to Refill the Cooling System.

### 3.6.3 Procedure to Flush and Clean Cooling System

Use the instructions in the engine operation manual when available to flush and clean the cooling system. Otherwise, use the following procedure and the cooling system cleaner manufacturer's instructions.

1. Flush the cooling system with clean water.
2. If the inside of the radiator still has mineral deposits, use a radiator cleaner to remove the remaining deposits following the manufacturer's instructions.
3. Drain, clean, and flush the coolant recovery tank.

### 3.6.4 Procedure to Refill Cooling System

See the generator set spec sheet for coolant capacity.

**Note:** Do not add coolant to a hot engine. Adding coolant to a hot engine can cause the cylinder block or cylinder head to crack. Wait until the engine has cooled.

1. Remove the pressure cap.
2. Close the radiator and/or engine block coolant drain valve(s) and tighten the cooling system hose clamps.
3. Open the air-bleed petcocks, if equipped. Close the air-bleed petcocks when coolant begins to flow from them.
4. Add coolant additives or water pump lubricants according to the engine manufacturer's recommendations in the engine operation manual.
5. Fill the cooling system with the recommended coolant/antifreeze mixture of 50% ethylene glycol and 50% clean, softened water to inhibit rust/corrosion and prevent freezing.

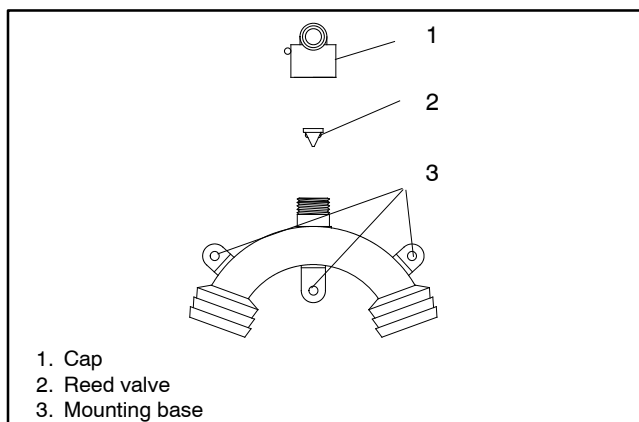
A coolant solution of 50% ethylene glycol provides freezing protection to  $-37^{\circ}\text{C}$  ( $-34^{\circ}\text{F}$ ) and overheating protection to  $129^{\circ}\text{C}$  ( $265^{\circ}\text{F}$ ). A coolant solution containing less than 50% ethylene glycol may not provide adequate freezing and overheating protection. A coolant solution containing more than 50% ethylene glycol can cause engine or component damage. Do not use alcohol or methanol antifreeze or mix them with the specified coolant. Refer to the engine operation manual for recommendations regarding the coolant mixture to use in extreme temperatures.

6. Replace the pressure cap.
7. Fill the coolant recovery tank to the low mark.
8. Operate generator set until the thermostat opens when the upper cooling system hose warms.
9. Stop the engine and allow it to cool.
10. Check and repair any coolant leaks.
11. Remove the pressure cap.
12. Add coolant to bring the coolant level to just below the overflow tube opening of the filler neck.
13. Replace the pressure cap.
14. Maintain the coolant level in the coolant recovery tank between the high and low marks. Air pockets often form in the engine water jacket when the coolant system is refilled. Check the coolant level in the coolant recovery tank after each generator set operation and add coolant as necessary until the coolant level stabilizes. Then check the coolant at the interval specified in the service schedule.
15. Reenergize the block heater, if equipped.

### 3.6.5 Siphon Break

A siphon break prevents seawater entry into the generator set's engine when the engine exhaust manifold outlet is less than 230 mm (9 in.) above the waterline of a fully loaded, docked or stationary craft. The siphon break may malfunction when the generator set operates while the craft is in contaminated waters or saltwater. Use the following procedure to inspect the siphon break at the intervals listed in the service schedule.

#### Siphon Break Inspection



**Figure 3-1** Siphon Break

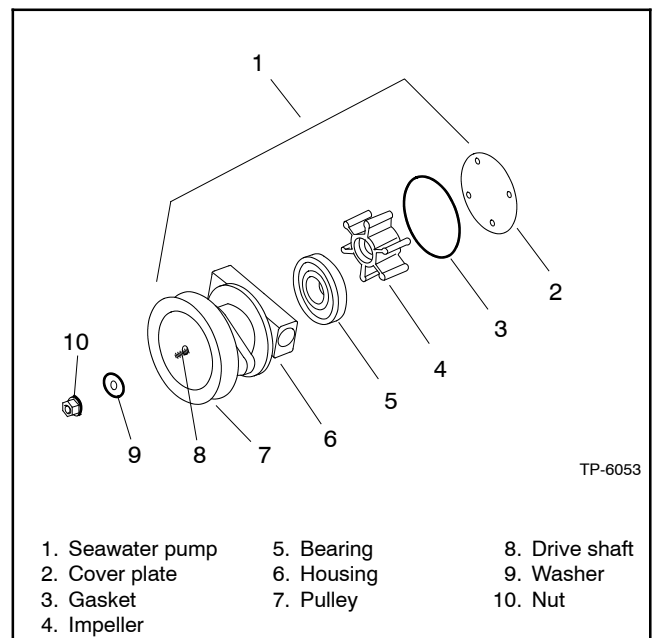
1. Stop the generator set.
2. Remove the retaining cap and remove the reed valve for inspection. See Figure 3-1.
3. Use a mild detergent to remove residue and oxidation from the reed valve.
4. Clear blockage from the reed valve opening.
5. Replace the siphon break if the reed valve is cracked or if the reed valve material has hardened or deteriorated.
6. Install the reed valve into the mounting base with the valve downward. See Figure 3-1, item 2.
7. Install and only finger tighten the retaining cap. Do not overtighten it.

### 3.6.6 Impeller Inspection and Replacement Procedure

The gear driven seawater pump is located on the service side of the generator set. Check and change the seawater pump impeller at the interval specified in the service schedule. Follow the instructions included with the impeller kit. If the instructions are not included with the kit, use the following procedure:

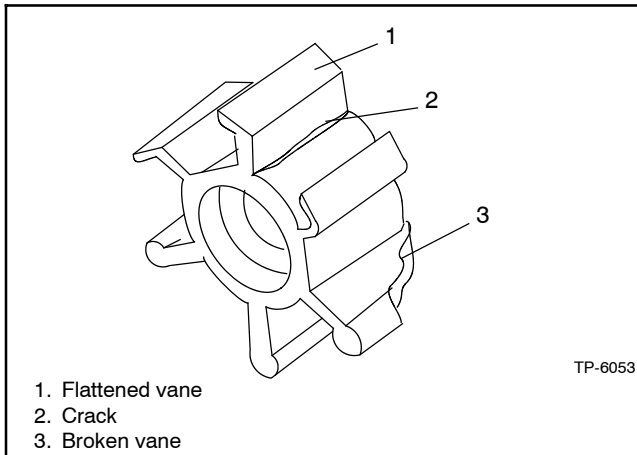
#### Impeller Inspection and Replacement Procedure:

1. Close the seacock.
2. Remove the seawater pump cover plate. See Figure 3-2.



**Figure 3-2** Seawater Pump, Typical

3. Remove the impeller.
4. Inspect the impeller for damaged, cracked, broken, missing or flattened vanes. The impeller vanes should be straight and flexible. See Figure 3-3. Replace the impeller if it is damaged.



**Figure 3-3** Worn Impeller

5. Lubricate the impeller with soapy water before installation.
6. Install the impeller.
 

**Note:** During installation push and rotate the impeller in the same direction as the engine rotation until it is thoroughly seated in the impeller housing.
7. Inspect the cover plate and gasket for corrosion and/or damage. Replace components as necessary.
8. Lubricate the gasket with silicon grease and attach the gasket and cover plate to the seawater pump housing.
9. Open the seacock.
10. Start the generator set and check for leaks.
11. Stop the generator set and repair leaks or replace damaged or worn components.

## 3.7 Exhaust System

|  |
|--|
| <b>⚠ WARNING</b>   |
|  |
| <p><b>Carbon monoxide.</b><br/>Can cause severe nausea, fainting, or death.</p> <p>The exhaust system must be leakproof and routinely inspected.</p> |

**Inspecting the exhaust system. Carbon monoxide can cause severe nausea, fainting, or death.** For the safety of the craft's occupants, install a carbon monoxide detector. Never operate the generator set without a functioning carbon monoxide detector. Inspect the detector before each generator set use.

At the interval specified in the service schedule, inspect the exhaust system components (exhaust manifold, mixing elbow, exhaust hose, hose clamps, silencer, and outlet flapper) for cracks, leaks, and corrosion.

Ensure that the carbon monoxide detector(s) is (1) in the craft, (2) functional, and (3) energized whenever the generator set operates.

**For your safety: Never operate the generator set without a functioning carbon monoxide detector(s) for your safety and the safety of others on your vessel.**

### Exhaust System Inspection Points

Check for exhaust leaks and blockages. Check the silencer and piping condition and check for tight exhaust system connections.

- Check the hoses for softness, cracks, leaks, or dents. Replace the hoses as needed.
- Check for corroded or broken metal parts and replace them as needed.
- Check for loose, corroded, or missing clamps. Tighten or replace the hose clamps and/or hangers as needed.
- Check that the exhaust outlet is unobstructed.
- Visually inspect the exhaust system for exhaust leaks (*blowby*). Check for carbon or soot residue on exhaust components. Carbon and soot residue indicates an exhaust leak. Seal leaks as needed.

## 3.8 Storage Procedure

Perform the following storage procedure before taking a generator set out of service for three months or longer. Follow the engine manufacturer's recommendations, if available, for fuel system and internal engine component storage.

### 3.8.1 Lubricating System

Prepare the engine lubricating system for storage as follows:

1. Run the generator set for a minimum of 30 minutes to bring it to normal operating temperature.
2. Stop the generator set.
3. With the engine still warm, drain the oil from the crankcase.
4. Remove and replace the oil filter.
5. Refill the crankcase with oil suited to the climate.
6. Run the generator set for two minutes to distribute the clean oil.
7. Stop the generator set.
8. Check the oil level and adjust, if needed.

### 3.8.2 Cooling System

Prepare the cooling system for storage as follows:

1. Check the coolant freeze protection using a coolant tester.
2. Add or replace coolant as necessary to ensure adequate freezing protection. Use the guidelines included in the engine operation manual.
3. Run the generator set for 30 minutes to redistribute added coolant.

### 3.8.3 Fuel System

Prepare the fuel system for storage as follows:

#### Diesel-Fueled Engines

1. Fill the fuel tank with #2 diesel fuel.
2. Condition the fuel system with compatible additives to control microbial growth.
3. Change the fuel filter/separator and bleed the fuel system. See the service manual.

### 3.8.4 Exterior

Prepare the exterior for storage as follows:

1. Clean the exterior surface of the generator set.
2. Seal all engine openings except for the air intake with nonabsorbent adhesive tape.
3. To prevent impurities from entering the air intake and to allow moisture to escape from the engine, secure a cloth over the air intake.
4. Mask electrical connections.
5. Spread a light film of oil over unpainted metallic surfaces to inhibit rust and corrosion.

### 3.8.5 Battery

Perform battery storage after all other storage procedures.

1. Place the generator set master switch in the OFF/RESET position.
2. Disconnect the battery(ies), negative (-) lead first.
3. Clean the battery. Refer to the battery manufacturer's instructions for the battery cleaning procedure.
4. Place the battery in a cool, dry location.
5. Connect the battery to a float/equalize battery charger or charge it monthly with a trickle battery charger. Refer to the battery charger manufacturer's recommendations.
6. Maintain a full charge to extend battery life.

## Notes

## Section 4 Troubleshooting

---

This section contains generator set troubleshooting, diagnostic, and repair information.

Use the following charts as a quick troubleshooting reference. The table groups generator set faults and suggests likely causes and remedies. The table also refers you to more detailed information including sections of this manual, the generator set service manual (S/M), the generator set installation manual (I/M), and the engine service manual (Engine S/M) to correct the indicated problem.

Corrective action and testing often require knowledge of electrical and electronic circuits. To avoid additional problems caused by incorrect repairs, have an authorized service distributor/dealer perform service.

### NOTICE

**Fuse replacement.** Replace fuses with fuses of the same ampere rating and type (for example: 3AB or 314, ceramic). Do not substitute clear glass-type fuses for ceramic fuses. Refer to the wiring diagram when the ampere rating is unknown or questionable.

Maintain a record of repairs and adjustments performed on the equipment. If the procedures in this manual do not explain how to correct the problem, contact an authorized distributor/dealer. Use the record to help describe the problem and repairs or adjustments made to the equipment.

| Trouble Symptoms  |                           |             |                          |                |             |           |                  |                       |                             |                                 |  | Probable Causes   | Recommended Actions  | Section or Publication Reference* |  |
|---|---------------------------|-------------|--------------------------|----------------|-------------|-----------|------------------|-----------------------|-----------------------------|---------------------------------|--|---|--|-----------------------------------|--|
| Does not crank  | Cranks but does not start | Starts hard | No or low output voltage | Stops suddenly | Lacks power | Overheats | Low oil pressure | High fuel consumption | Excessive or abnormal noise | Displays error message/locks up | Exercise run time and/or event records inoperative |   |  |                                   |  |
| Controller  |                           |             |                          |                |             |           |                  |                       |                             |                                 |  |   |  |                                   |  |
| x   | x                         |             |                          |                |             |           |                  |                       |                             |                                 |  | Controller circuit board(s) inoperative.                | Replace the controller circuit board.  | Gen. S/M                          |  |
| x   | x                         |             |                          |                |             |           |                  |                       |                             |                                 |  | Controller circuit board(s) wiring fault.               | Check the wiring.  | W/D                               |  |
|   |                           |             |                          | x              |             |           |                  |                       |                             |                                 |  | Controller fault.                                       | Troubleshoot the controller.†  | Gen. S/M                          |  |
| x   | x                         |             |                          | x              |             |           |                  |                       |                             |                                 |  | Controller fuse blown.                                  | Check for continuity across the fuse. If fuse is blown, troubleshoot controller wiring and replace the circuit board. †            | Section 1, W/D                    |  |
| x   |                           |             |                          |                |             |           |                  |                       |                             |                                 |  | Controller master control buttons inoperative.          | Replace the controller master control button circuit board.  | —                                 |  |
| x   |                           |             |                          |                |             |           |                  |                       |                             |                                 |  | Controller master control button in the OFF/RESET mode. | Press the controller master control RUN or AUTO button.  | Section 2                         |  |
| x   |                           |             |                          |                |             |           |                  |                       |                             |                                 |  | Engine start circuit open.                              | Press the controller master control RUN button to test the generator set. Troubleshoot the auto start circuit and the time delays. | Section 2, W/D, Gen. S/M          |  |
| x   |                           |             |                          | x              |             |           |                  |                       |                             |                                 |  | Emergency stop switch activated, if equipped.           | Reset the emergency stop switch.   | Section 2                         |  |
|   |                           |             | x                        | x              |             |           |                  |                       |                             |                                 |  | Voltage regulator inoperative.                          | Replace the junction box sensing fuses. If the fuse blows again, troubleshoot the controller.                                      | W/D, Gen. S/M                     |  |
|   |                           |             |                          |                |             |           |                  |                       |                             | x                               |  | Controller firmware error.                              | Review the controller display troubleshooting chart.   | Section 4.1                       |  |
| Alternator  |                           |             |                          |                |             |           |                  |                       |                             |                                 |  |   |  |                                   |  |
|   |                           |             | x                        |                |             |           |                  |                       |                             |                                 |  | AC output circuit breaker open.                         | Reset the breaker and check for AC voltage at the generator set side of the circuit breaker.                                       | —                                 |  |
| x   |                           |             |                          |                |             |           |                  |                       |                             |                                 |  | Transfer switch test switch in the OFF position.        | Move the transfer switch test switch to the AUTO position.   | —                                 |  |
|   |                           |             | x                        |                |             |           |                  |                       |                             |                                 |  | Wiring, terminals, or pin in the exciter field open.    | Check for continuity.  | Gen. S/M or W/D                   |  |
|   |                           |             | x                        |                |             |           |                  |                       |                             |                                 |  | Main field (rotor) inoperative (open or grounded).      | Test and/or replace the rotor. †   | Gen. S/M                          |  |
|   |                           |             | x                        |                |             |           |                  |                       |                             |                                 |  | Stator inoperative (open or grounded).                  | Test and/or replace the stator. †  | Gen. S/M                          |  |
|   |                           |             |                          |                |             |           |                  |                       | x                           |                                 |  | Vibration excessive.                                    | Tighten loose components. †  | —                                 |  |
|   |                           |             | x                        | x              |             |           |                  |                       |                             |                                 |  | Voltage regulator settings incorrect.                   | Adjust the voltage regulator.  | SiteTech O/M                      |  |
| Electrical System (DC circuits)   |                           |             |                          |                |             |           |                  |                       |                             |                                 |  |   |  |                                   |  |
| * Sec./Section—numbered section of this manual; ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; W/D—Wiring Diagram |                           |             |                          |                |             |           |                  |                       |                             |                                 |  |   |  |                                   |  |
| † Have an authorized service distributor/dealer perform this service.   |                           |             |                          |                |             |           |                  |                       |                             |                                 |  |   |  |                                   |  |

\* Sec./Section—numbered section of this manual; ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; W/D—Wiring Diagram  
† Have an authorized service distributor/dealer perform this service.



| Trouble Symptoms |                           |             |                          |                |             |           |                  |                       |                             | Probable Causes                                    | Recommended Actions   | Section or Publication Reference* |
|------------------|---------------------------|-------------|--------------------------|----------------|-------------|-----------|------------------|-----------------------|-----------------------------|--|---|-----------------------------------|
| Does not crank   | Cranks but does not start | Starts hard | No or low output voltage | Stops suddenly | Lacks power | Overheats | Low oil pressure | High fuel consumption | Excessive or abnormal noise |  |   |                                   |
|                  |                           |             |                          |                |             |           |                  |                       |                             | Exercise run time and/or event records inoperative |   |                                   |
| x                | x                         |             |                          |                |             |           |                  |                       |                             | Battery connections loose, corroded, or incorrect. | Verify that the battery connections are correct, clean, and tight.                                | —                                 |
| x                | x                         |             |                          |                |             |           |                  |                       |                             | Battery weak or dead.                              | Recharge or replace the battery. The spec sheet provides recommended battery CCA rating.          | Eng. O/M, S/S                     |
| x                | x                         |             |                          |                |             |           |                  |                       |                             | Starter/starter solenoid inoperative.              | Replace the starter or starter solenoid.  | Eng. S/M                          |
| x                |                           |             |                          | x              |             |           |                  |                       |                             | Engine harness connector(s) not locked tight.      | Disconnect the engine harness connector(s) then reconnect it to the controller.                   | W/D                               |
|                  |                           |             |                          | x              |             |           |                  |                       |                             | Fault shutdown.                                    | Reset the fault switches and troubleshoot the controller.   | Section 2                         |
|                  |                           |             |                          | x              |             |           |                  |                       |                             | High exhaust temperature switch inoperative.       | Replace the inoperative switch.   | Gen. S/M or W/D                   |
| <b>Engine</b>    |                           |             |                          |                |             |           |                  |                       |                             |  |   |                                   |
|                  | x                         | x           |                          |                | x           |           |                  | x                     |                             | Air cleaner/backfire flame arrestor clogged.       | Clean or replace the filter element.  | Eng. O/M                          |
|                  | x                         | x           |                          |                |             | x         |                  | x                     | x                           | Compression weak.                                  | Check the compression. †  | Eng. S/M                          |
|                  |                           |             | x                        | x              | x           | x         |                  | x                     |                             | Engine overload.                                   | Reduce the electrical load. See the generator set installation manual for wattage specifications. | I/M                               |
|                  |                           |             |                          |                |             |           |                  |                       | x                           | Exhaust system leak.                               | Inspect the exhaust system. Replace the inoperative exhaust system components. †                  | Section 3, I/M                    |
|                  |                           |             |                          |                |             |           |                  | x                     |                             | Exhaust system not securely installed.             | Inspect the exhaust system. Tighten the loose exhaust system components. †                        | Section 3, I/M                    |
|                  |                           | x           | x                        | x              | x           |           | x                |                       |                             | Governor inoperative.                              | Adjust the governor. †  | Gen. S/M                          |
|                  |                           |             |                          | x              | x           |           |                  | x                     | x                           | Valve clearance incorrect.                         | Adjust the valves. †  | Eng. O/M                          |
|                  |                           |             |                          |                |             |           |                  |                       | x                           | Vibration excessive.                               | Tighten all loose hardware.   | —                                 |
| x                | x                         |             |                          | x              |             |           |                  |                       | x                           | Engine ECM and/or sensors.                         | Troubleshoot the engine ECM and/or sensors.   | Eng. O/M, Eng. S/M                |

\* Sec./Section—numbered section of this manual; ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; W/D—Wiring Diagram

† Have an authorized service distributor/dealer perform this service.

| Trouble Symptoms          |                           |             |                          |                |             |           |                  |                       |                             |                                 |  | Probable Causes  | Recommended Actions  | Section or Publication Reference* |
|---------------------------|---------------------------|-------------|--------------------------|----------------|-------------|-----------|------------------|-----------------------|-----------------------------|---------------------------------|--|--|----------------------|-----------------------------------|
| Does not crank            | Cranks but does not start | Starts hard | No or low output voltage | Stops suddenly | Lacks power | Overheats | Low oil pressure | High fuel consumption | Excessive or abnormal noise | Displays error message/locks up | Exercise run time and/or event records inoperative     |  |                      |                                   |
| Cooling System            |                           |             |                          |                |             |           |                  |                       |                             |                                 |  |  |                      |                                   |
|                           |                           |             |                          |                |             | x         |                  | x                     |                             |                                 | Air openings clogged.                                  | Clean the air openings.  | —                    |                                   |
|                           |                           |             |                          |                |             | x         |                  |                       |                             |                                 | Impeller inoperative.                                  | Replace the impeller.  | Section 3            |                                   |
|                           |                           |             |                          |                |             | x         |                  | x                     |                             |                                 | Seawater strainer clogged or restricted.               | Clean the strainer.  | Section 3            |                                   |
|                           |                           |             |                          | x              |             |           |                  |                       |                             |                                 | High temperature shutdown.                             | Allow the engine to cool down. Then troubleshoot the cooling system.         | Eng. O/M             |                                   |
|                           |                           |             |                          | x              |             |           |                  |                       |                             |                                 | Low coolant level shutdown, if equipped.               | Restore the coolant to normal operating level.                               | Eng. O/M             |                                   |
|                           |                           |             |                          |                | x           |           |                  |                       |                             |                                 | Coolant level low.                                     | Restore the coolant to normal operating level.                               | Eng. O/M             |                                   |
|                           |                           |             |                          |                | x           |           |                  |                       |                             |                                 | Cooling water pump inoperative.                        | Tighten or replace the belt. Replace the water pump.                         | Eng. O/M or Eng. S/M |                                   |
|                           |                           |             |                          |                | x           |           |                  |                       |                             |                                 | Thermostat inoperative.                                | Replace the thermostat.  | Eng. S/M             |                                   |
| Fuel System               |                           |             |                          |                |             |           |                  |                       |                             |                                 |  |  |                      |                                   |
| x                         |                           |             |                          | x              |             |           |                  |                       |                             |                                 | Fuel tank empty or fuel valve shut off.                | Add fuel and move the fuel valve to the ON position.                         | —                    |                                   |
| x                         | x                         |             |                          |                | x           |           |                  |                       |                             |                                 | Air in fuel system (diesel only).                      | Bleed the diesel fuel system.  | Eng. O/M             |                                   |
| x                         | x                         |             |                          |                | x           |           |                  |                       |                             |                                 | Fuel or fuel injectors dirty or faulty (diesel only).  | Clean, test, and/or replace the inoperative fuel injector.†                  | Eng. S/M             |                                   |
| x                         | x                         |             |                          |                | x           |           |                  | x                     |                             |                                 | Fuel injection timing out of adjustment (diesel only). | Adjust the fuel injection timing.†   | Eng. S/M             |                                   |
| x                         |                           |             |                          |                | x           |           |                  | x                     |                             |                                 | Fuel feed or injection pump inoperative (diesel only). | Rebuild or replace the injection pump.†                                      | Eng. S/M             |                                   |
| x                         | x                         |             |                          | x              | x           |           |                  |                       |                             |                                 | Fuel filter restriction.                               | Clean or replace the fuel filter.†   | Eng. O/M             |                                   |
| Engine Lubrication System |                           |             |                          |                |             |           |                  |                       |                             |                                 |  |  |                      |                                   |
|                           |                           |             |                          |                |             | x         | x                |                       | x                           |                                 | Oil level low.   | Restore the oil level. Inspect the generator set for oil leaks.              | Eng. O/M             |                                   |
|                           |                           |             |                          | x              |             |           |                  |                       |                             |                                 | Low oil pressure shutdown.                             | Check the oil level.   | Eng. O/M             |                                   |
| x                         | x                         |             |                          |                |             |           | x                |                       | x                           |                                 | Crankcase oil type incorrect for ambient temperature.  | Change the oil. Use oil with a viscosity suitable for the operating climate. | Eng. O/M             |                                   |

\* Sec./Section—numbered section of this manual; ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; W/D—Wiring Diagram

† Have an authorized service distributor/dealer perform this service.

\* Sec./Section—numbered section of this manual; ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; W/D—Wiring Diagram

† Have an authorized service distributor/dealer perform this service.

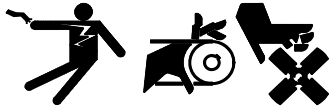
## 4.1 Controller Display and Voltage Regulation Troubleshooting Chart

| Trouble Symptoms   | Probable Causes   | Recommended Actions                               | Section or Publication Reference* |
|--|---|---|-----------------------------------|
| <b>Controller Display and Voltage Regulator</b>  |   |   |                                   |
| Display is black.  | No/low battery charge.  | Recharge/replace battery.                         | —                                 |
| Display shows single segment.  | Low battery voltage.  | Recharge battery.                                 | —                                 |
| Display shows an error message.  | Controller firmware or pushbutton/rotary selector dial entry error. | Review the Error Message section.                 | —                                 |
| Display locks up.  | No/low battery charge.  | Recharge/replace battery.                         | —                                 |
| Output voltage ramps.  | Defective exciter winding.  | Troubleshoot alternator components. †             | Generator Service Manual          |
| Output voltage unstable.   | Voltage regulation calibration incorrect.                           | Readjust voltage regulation. †                    | SiteTech O/M                      |
| Unable to change voltage and current calibrations.   | Calibration not enabled.  | Enable calibration in Generator Metering section. | Section 1.7.3 Graphical Display   |
| <p>* Sec./Section—numbered section of this manual; ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; W/D—Wiring Diagram Manual</p> <p>† Have an authorized service distributor/dealer perform this service.</p> |   |   |                                   |

## Notes

## Section 5 Wiring Diagrams

### WARNING

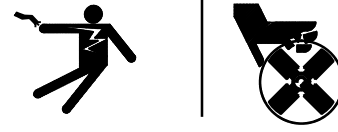


**Accidental starting.**  
**Can cause severe injury or death.**

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

**Disabling the generator set. Accidental starting can cause severe injury or death.** Before working on the generator set or equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

### WARNING



**Hazardous voltage. Moving parts.**  
**Can cause severe injury or death.**

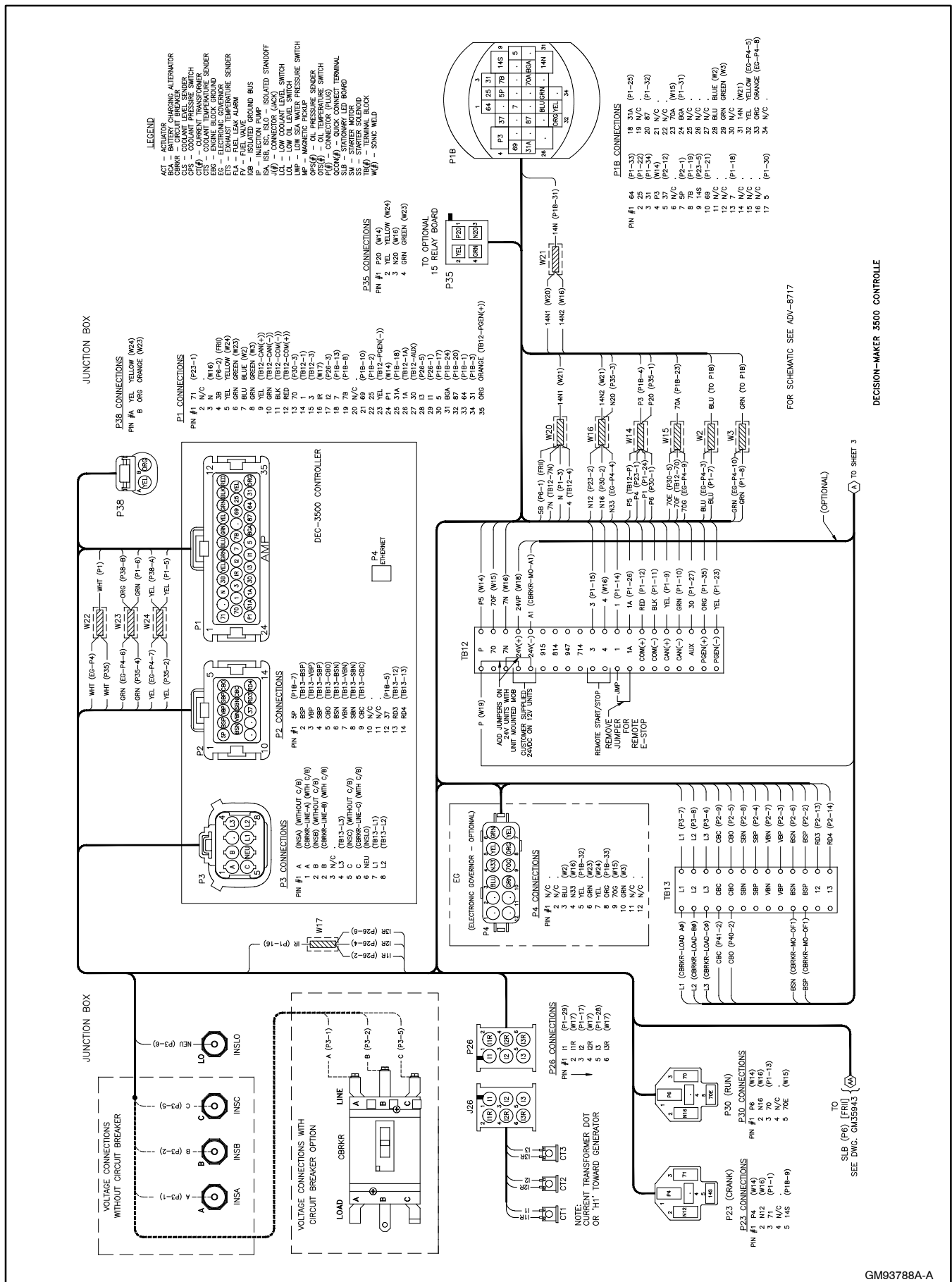
Operate the generator set only when all guards and electrical enclosures are in place.

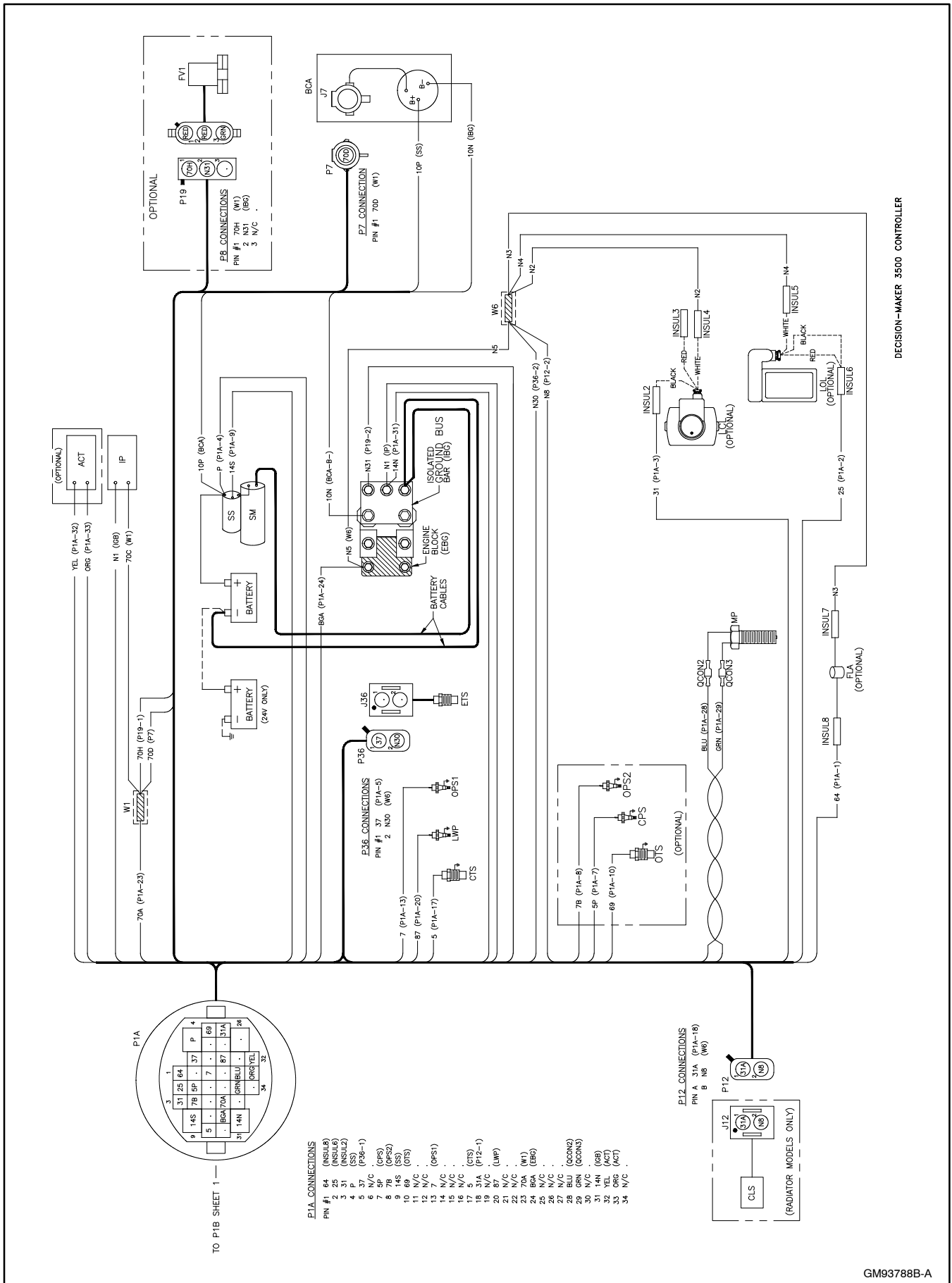
**Grounding electrical equipment. Hazardous voltage can cause severe injury or death.** Electrocutation is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

**Short circuits. Hazardous voltage/current can cause severe injury or death.** Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

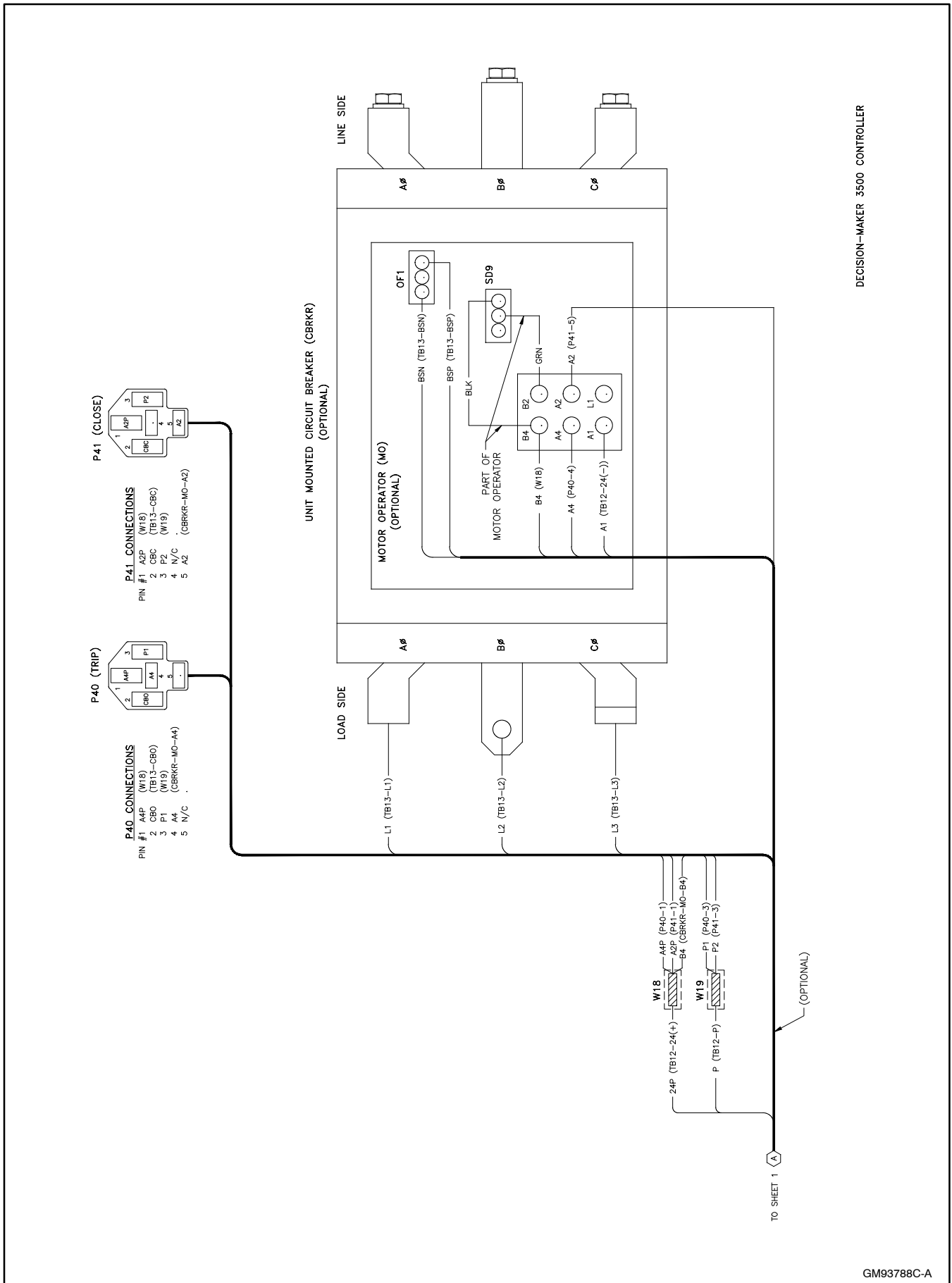
| Model                       | Controller           | Wiring Diagram | Figure                                    | Schematic  | Figure                     | Voltage Reconnection | Figure     |
|-----------------------------|----------------------|----------------|---|------------|----------------------------|----------------------|------------|
| 40EOZD(C)J<br>33EFOZD(C)J   | Decision-Maker® 3500 | GM93788-A      | Figure 5-1<br>Figure 5-2<br>Figure 5-3    | ADV-8717-A | Figure 5-4<br>Figure 5-5   | ADV-5875F-R          | Figure 6-1 |
| 40EFOZD(C)J                 |                      | GM93789-A      | Figure 5-6<br>Figure 5-7<br>Figure 5-8    | ADV-8718-A | Figure 5-9<br>Figure 5-10  |                      |            |
| 50EFOZD(C)J                 |                      |                |   |            |                            |                      |            |
| 55EOZD(C)J<br>45EFOZD(C)J   |                      | GM93790-A      | Figure 5-11<br>Figure 5-12<br>Figure 5-13 | ADV-8719-A | Figure 5-14<br>Figure 5-15 |                      |            |
| 65EOZD(C)J<br>55EFOZD(C)J   |                      | GM93791-A      | Figure 5-16<br>Figure 5-17<br>Figure 5-18 | ADV-8720-A | Figure 5-19<br>Figure 5-20 |                      |            |
| 80EOZD(C)J<br>70EFOZD(C)J   |                      |                |   |            |                            |                      |            |
| 99EOZD(C)J<br>80EFOZD(C)J   |                      |                |   |            |                            |                      |            |
| 125EOZD(C)J<br>100EFOZD(C)J |                      | GM93792-A      | Figure 5-21<br>Figure 5-22<br>Figure 5-23 | ADV-8721-A | Figure 5-24<br>Figure 5-25 |                      |            |
| 150EOZD(C)J<br>125EFOZD(C)J |                      |                |   |            |                            |                      |            |

|  |           |             |
|--|-----------|-------------|
| DWG.GM35943, Wiring Diagram                      | GM35943-D | Figure 5-26 |
| Interconnection Diagram for Decision-Maker® 3500 | GM88254   | Figure 5-27 |





**Figure 5-2** 40EOZD(C)J and 33EFOZD(C)J Wiring Diagram, Decision-Maker® 3500, Sheet 2 of 3



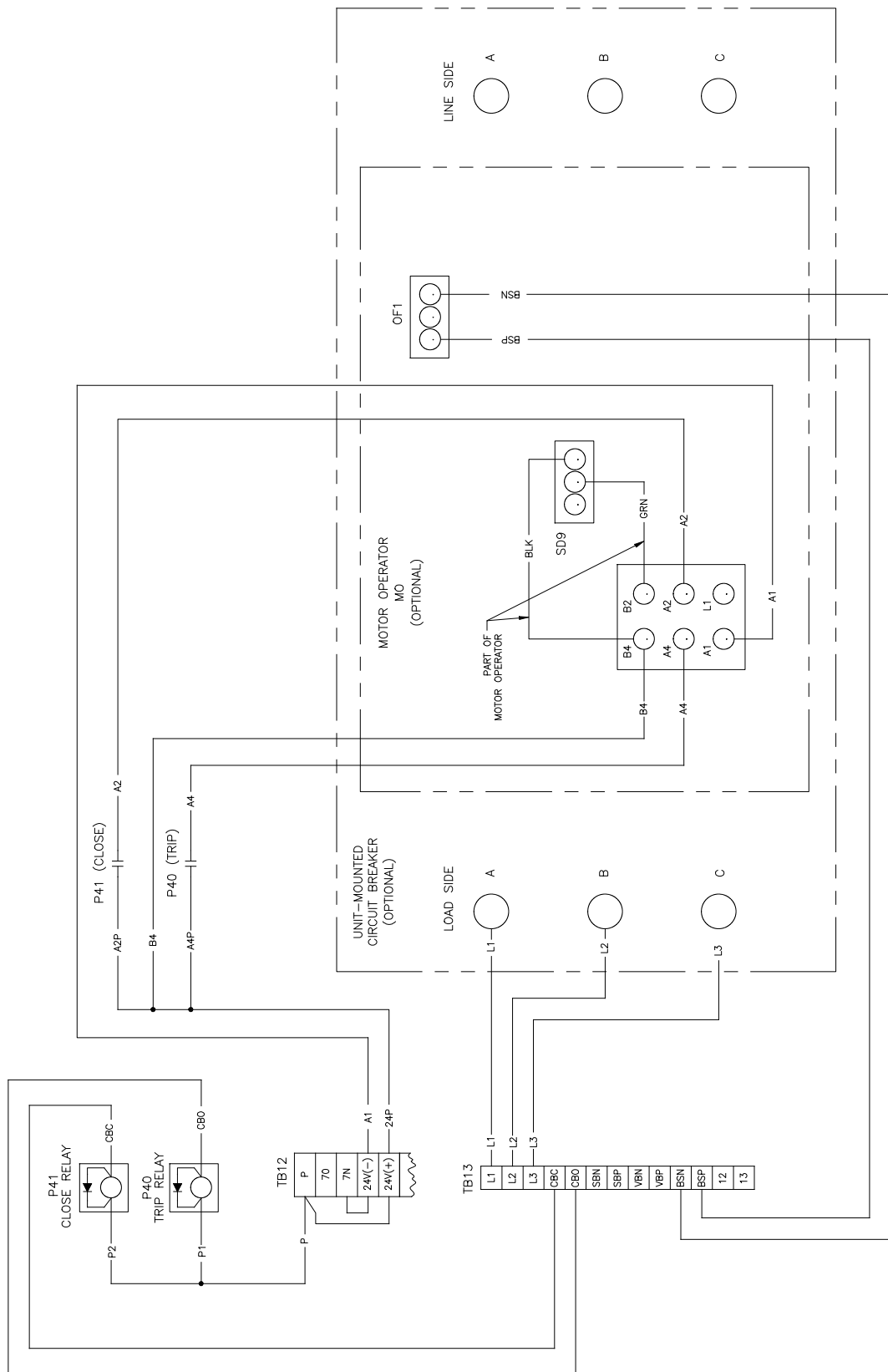
DECISION-MAKER 3500 CONTROLLER

GM93788C-A

**Figure 5-3** 40EOZD(C)J and 33EFOZD(C)J Wiring Diagram, Decision-Maker® 3500, Sheet 3 of 3







DECISION-MAKER 3500 CONTROLLER

ADV-8717B-A

**Figure 5-5** 40EOZD(C)J and 33EFOZD(C)J Schematic, Decision-Maker® 3500, Sheet 2 of 2



GM93789A-A

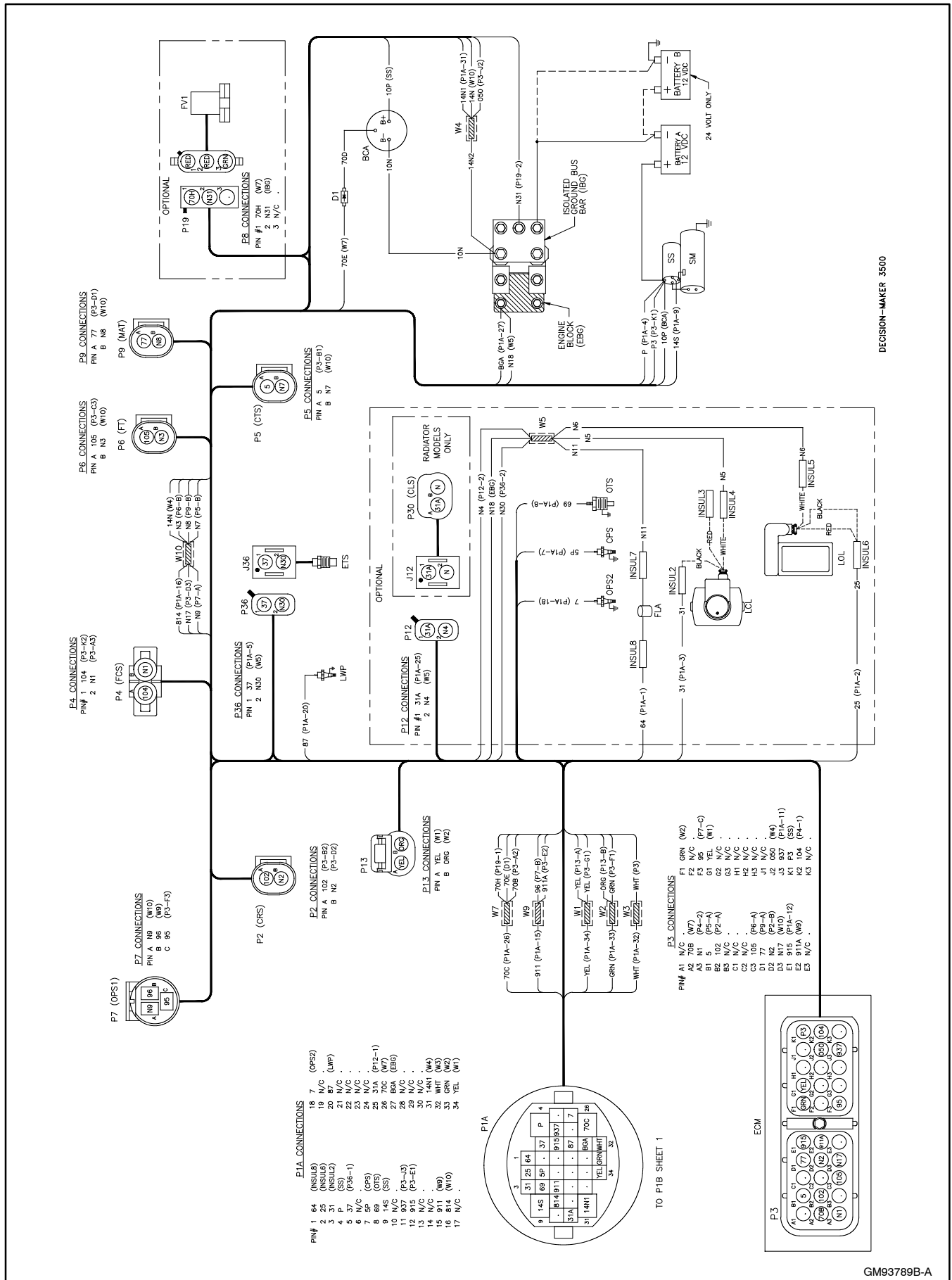
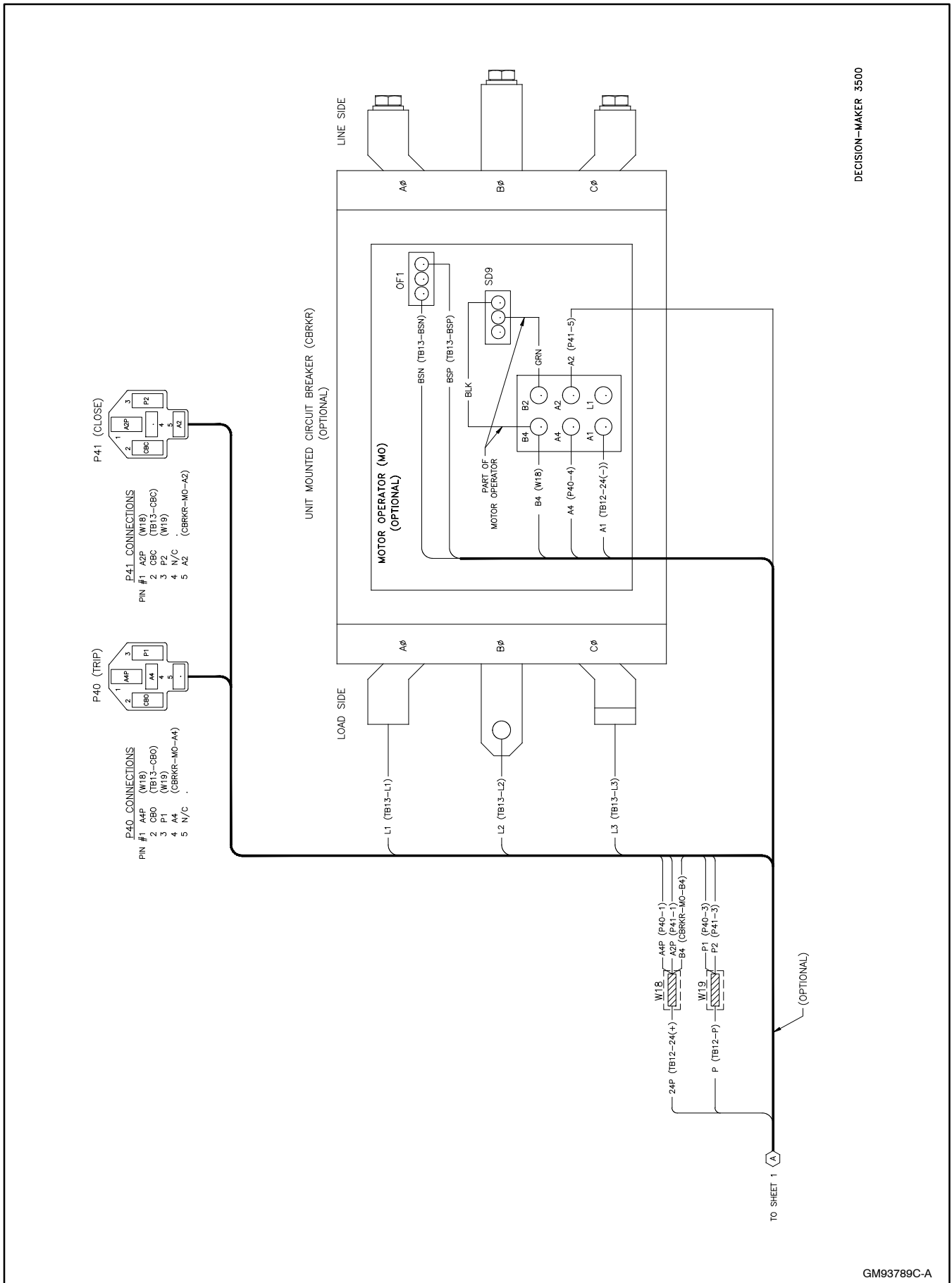
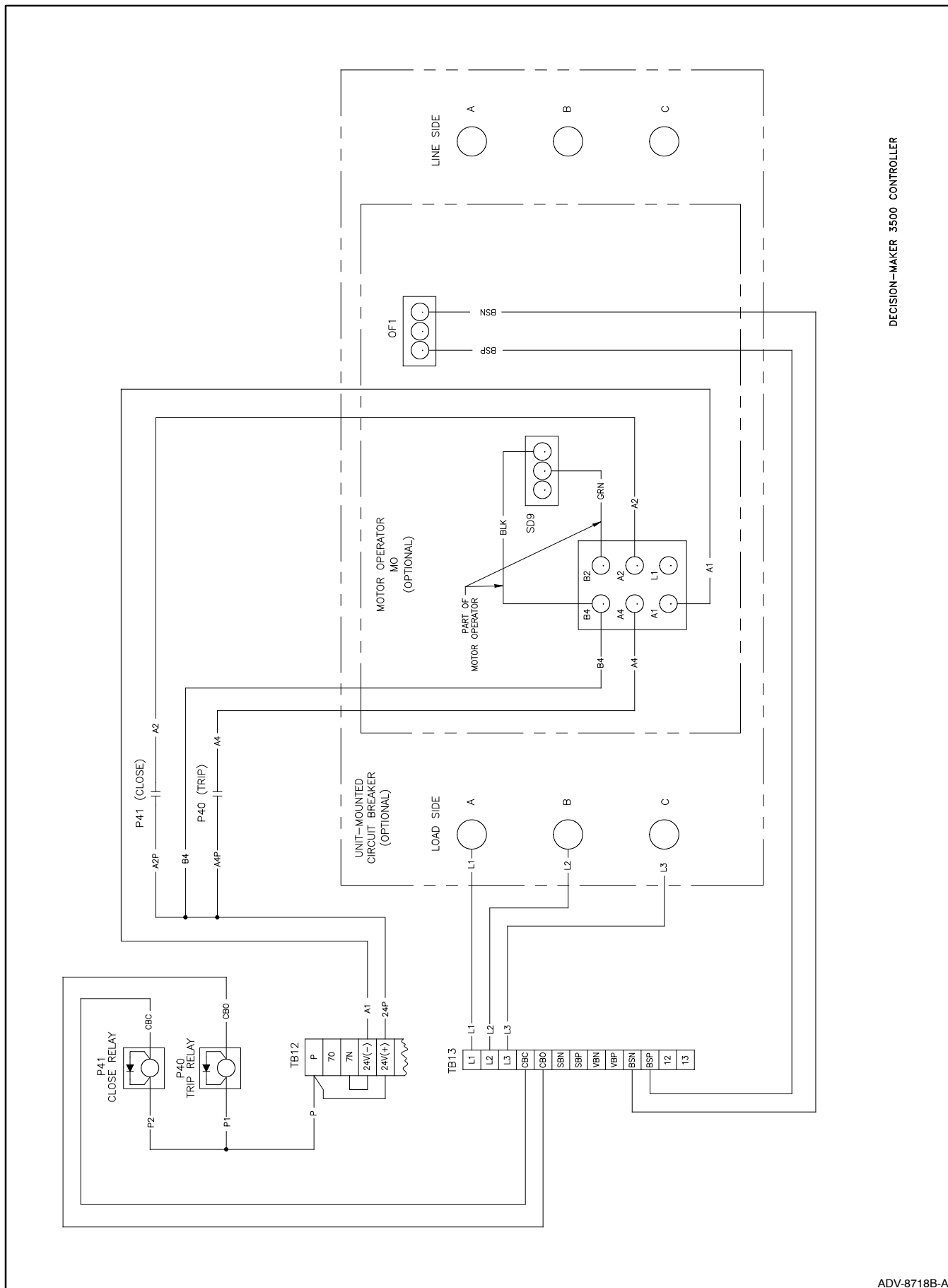


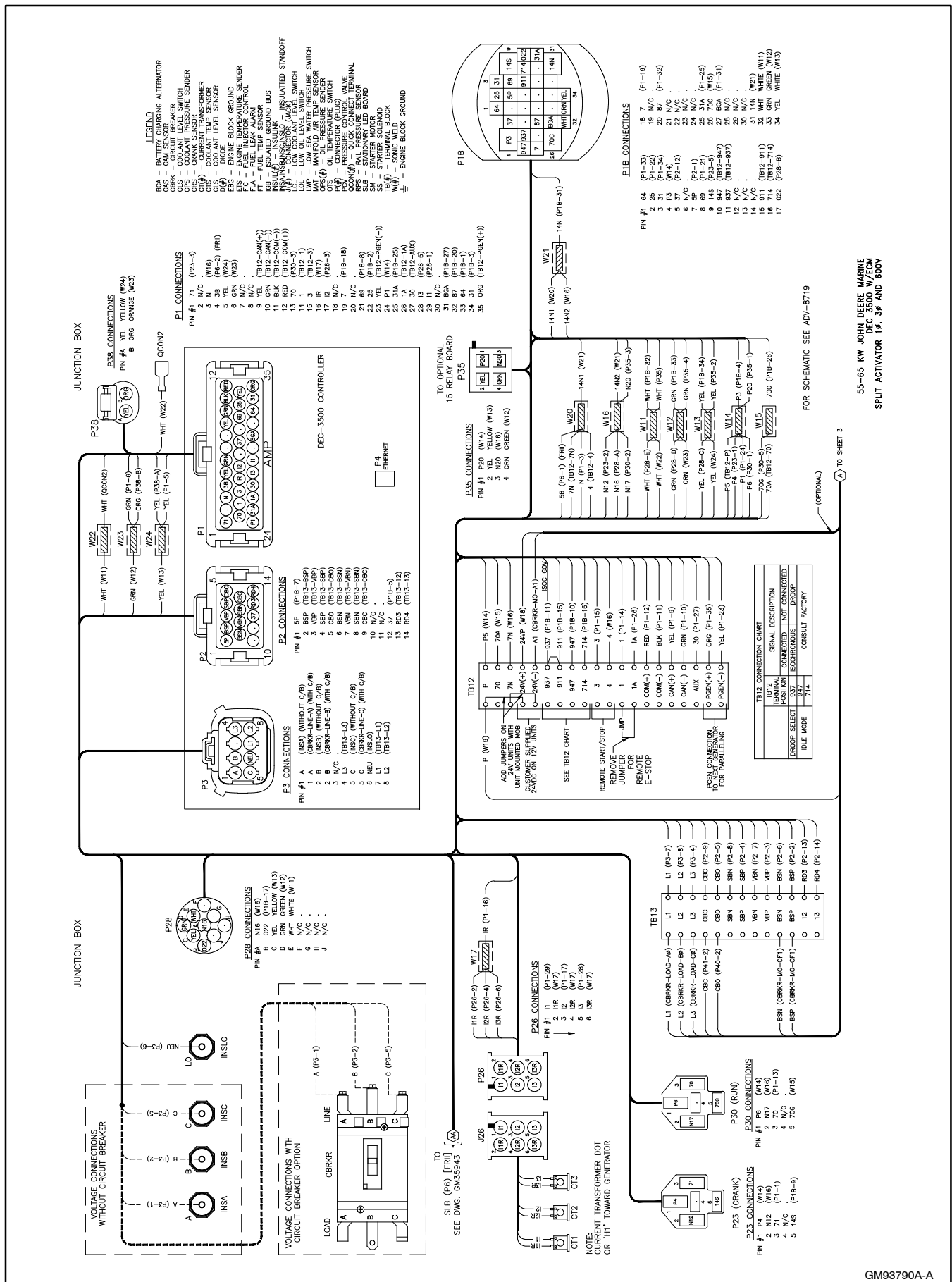
Figure 5-7 40EFOZD(C)J and 50EFOZD(C)J Wiring Diagram, Decision-Maker® 3500, Sheet 2 of 3



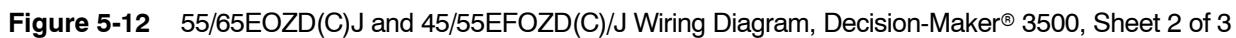


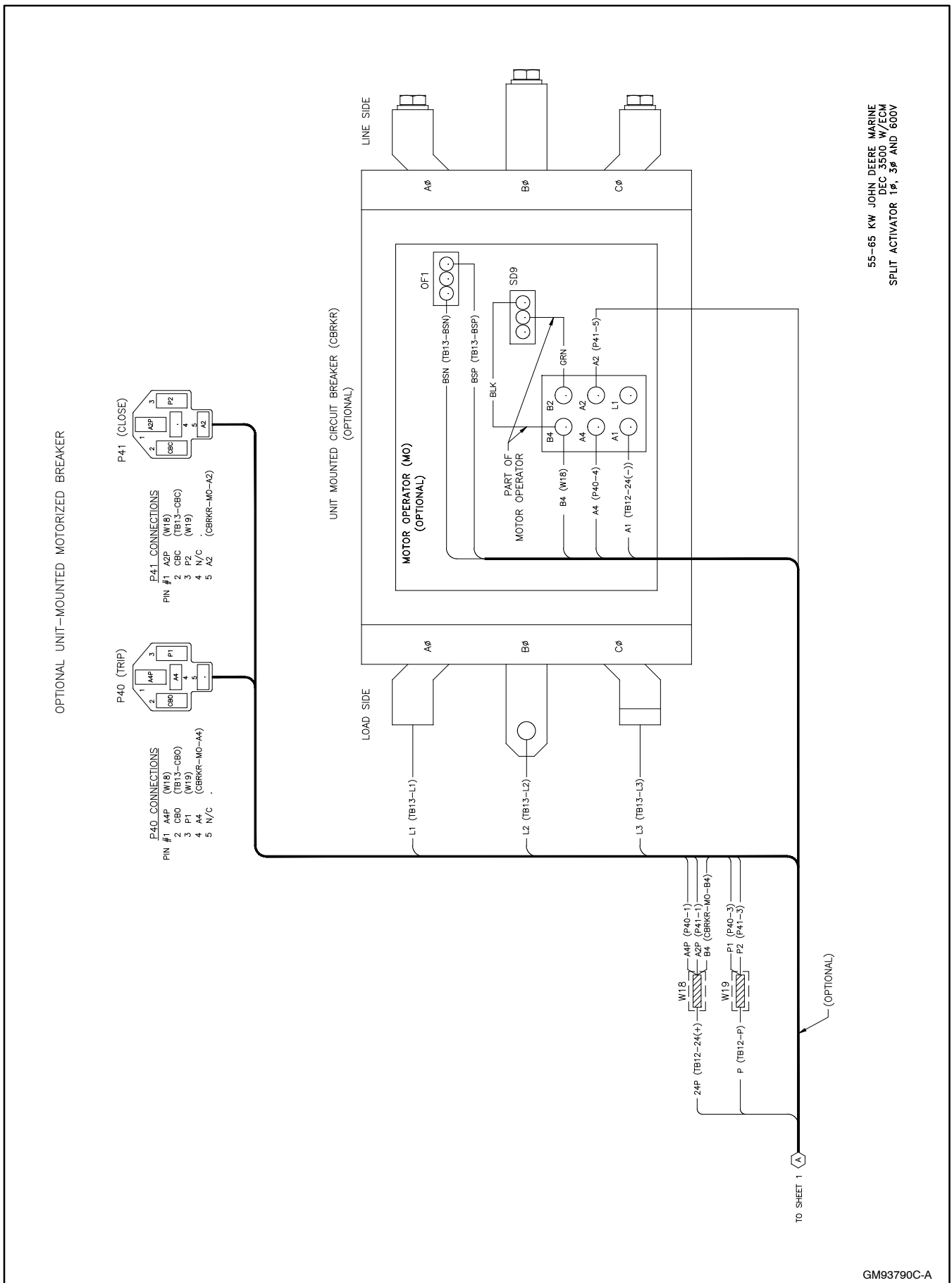


**Figure 5-10** 40EFOZD(C)J and 50EFOZD(C)J Schematic, Decision-Maker® 3500, Sheet 2 of 2



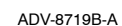




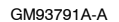


**Figure 5-13** 55/65EOZD(C)J and 45/55EFOZD(C)/J Wiring Diagram, Decision-Maker® 3500, Sheet 3 of 3





TP-6861 10/14



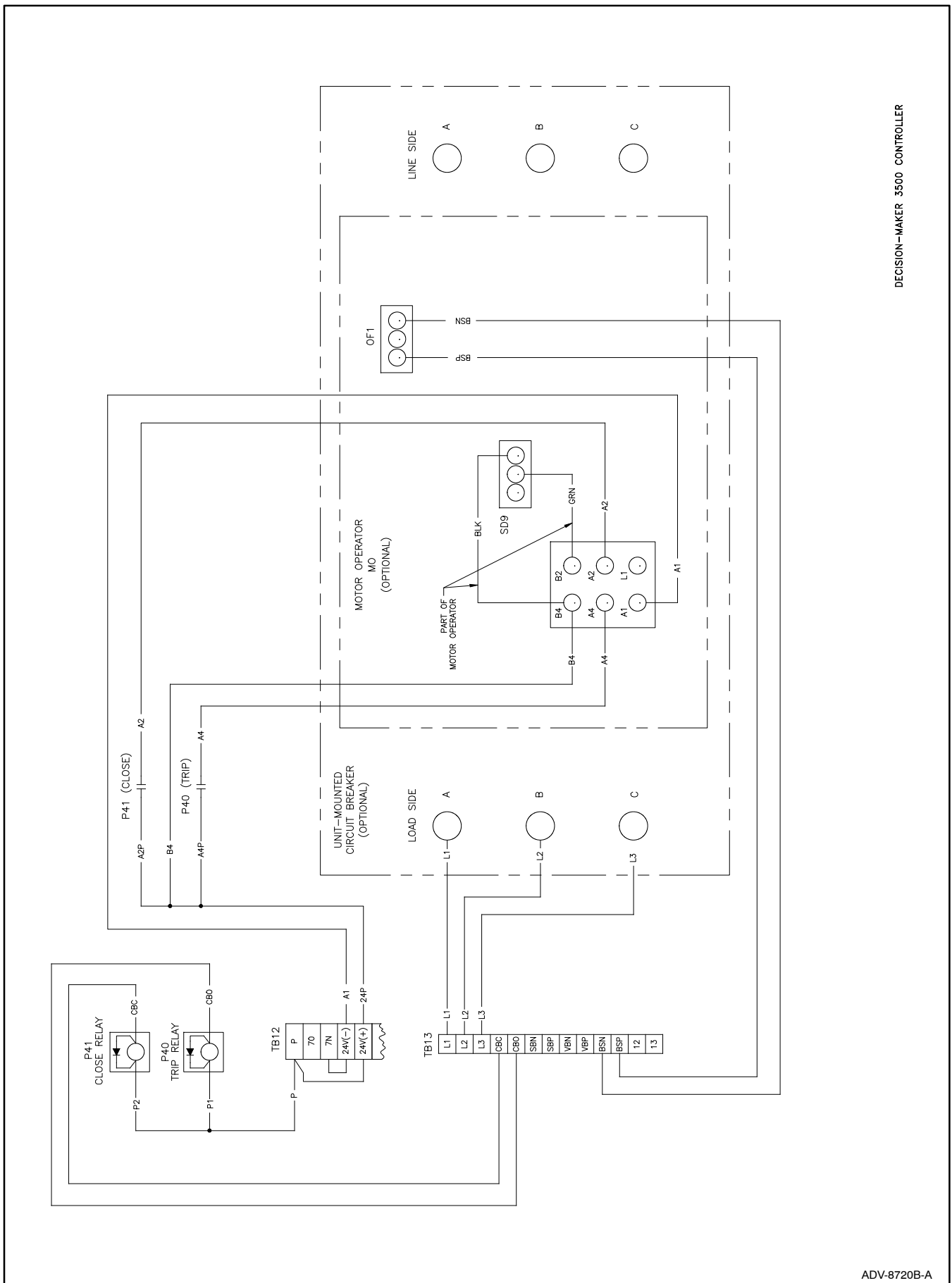
TP-6861 10/14



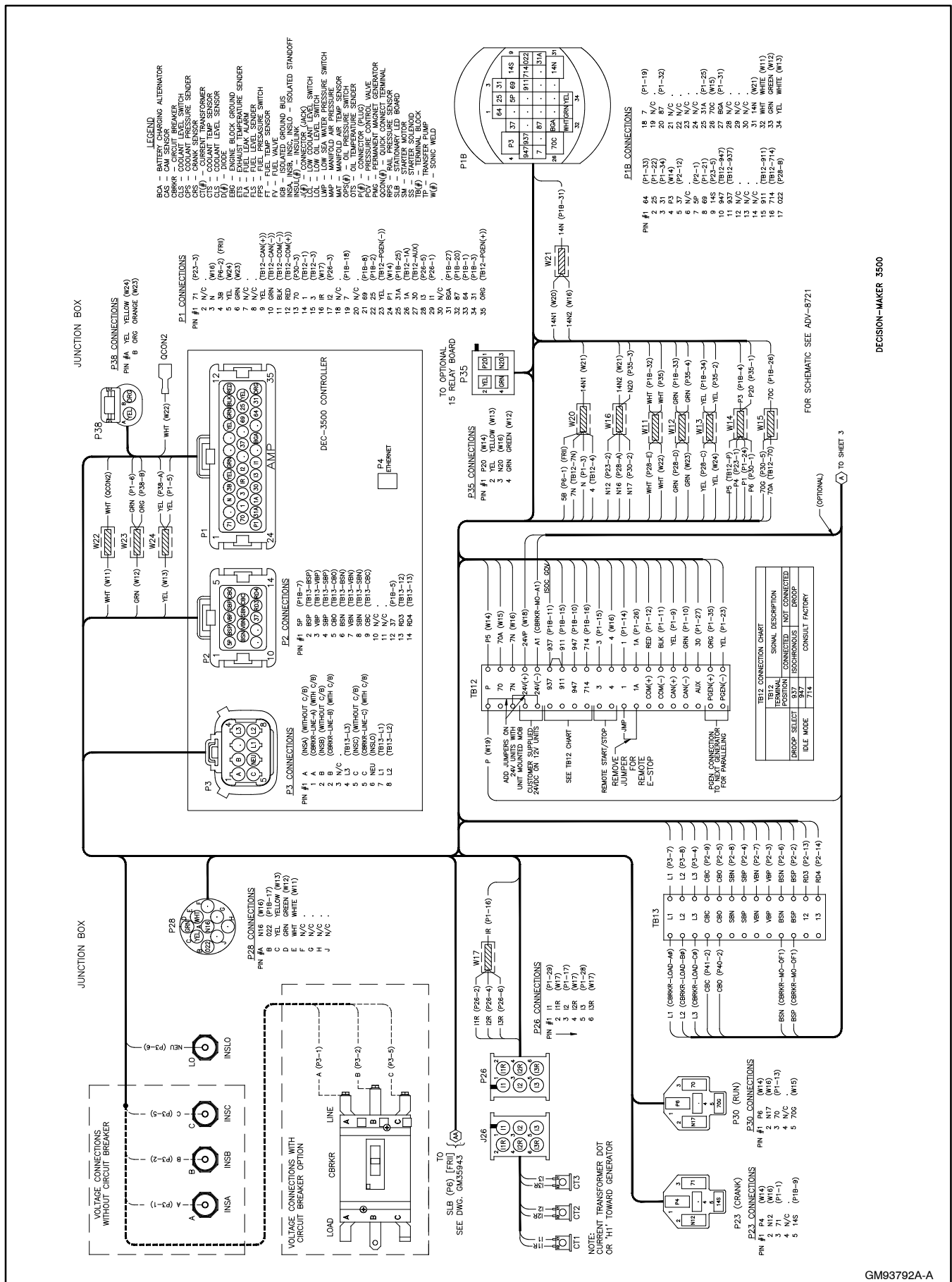


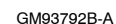




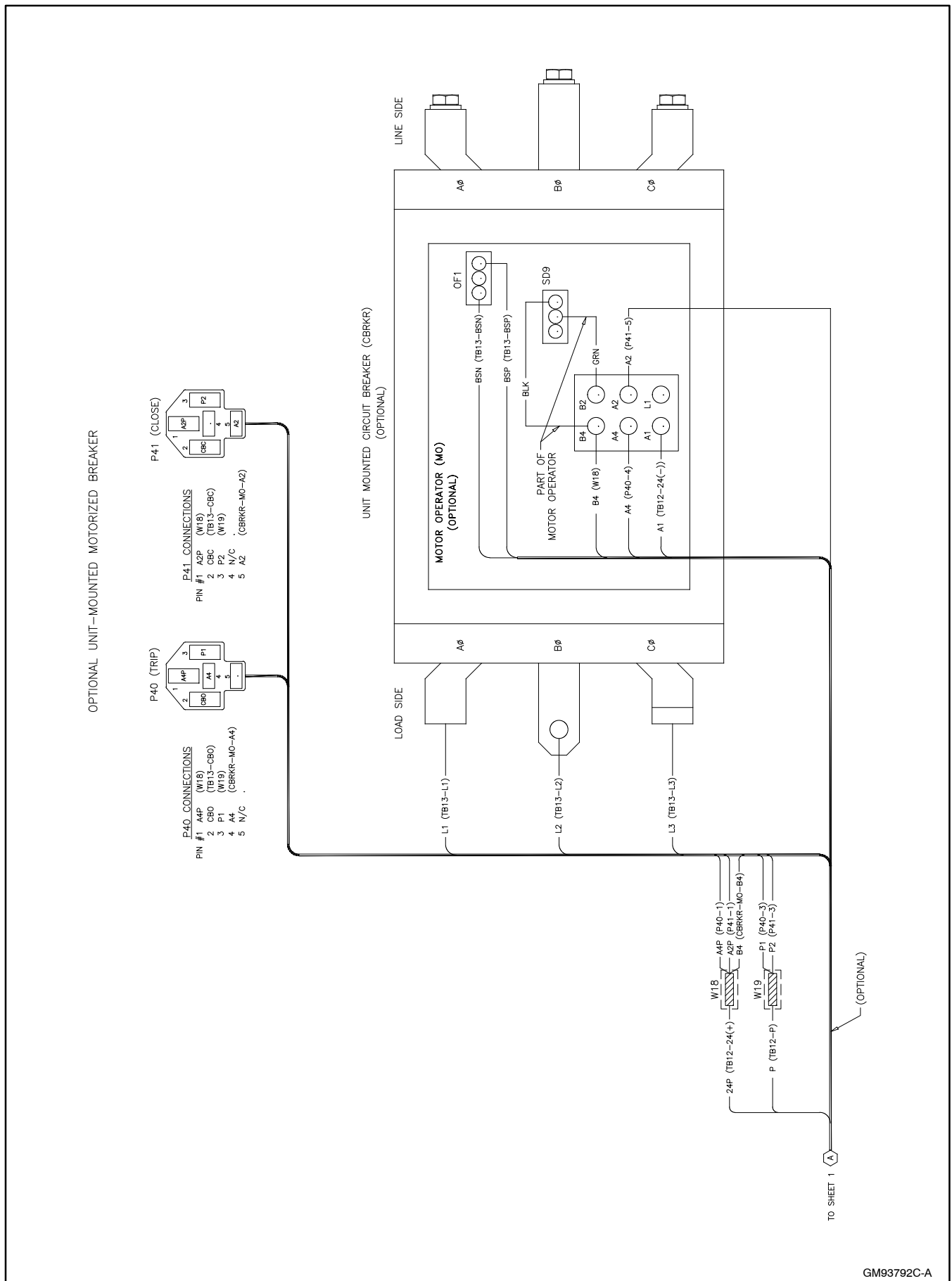


**Figure 5-20** 80/99EOZD(C)J and 70/80EFOZD(C)J Schematic, Decision-Maker® 3500, Sheet 2 of 2

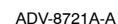




TP-6861 10/14

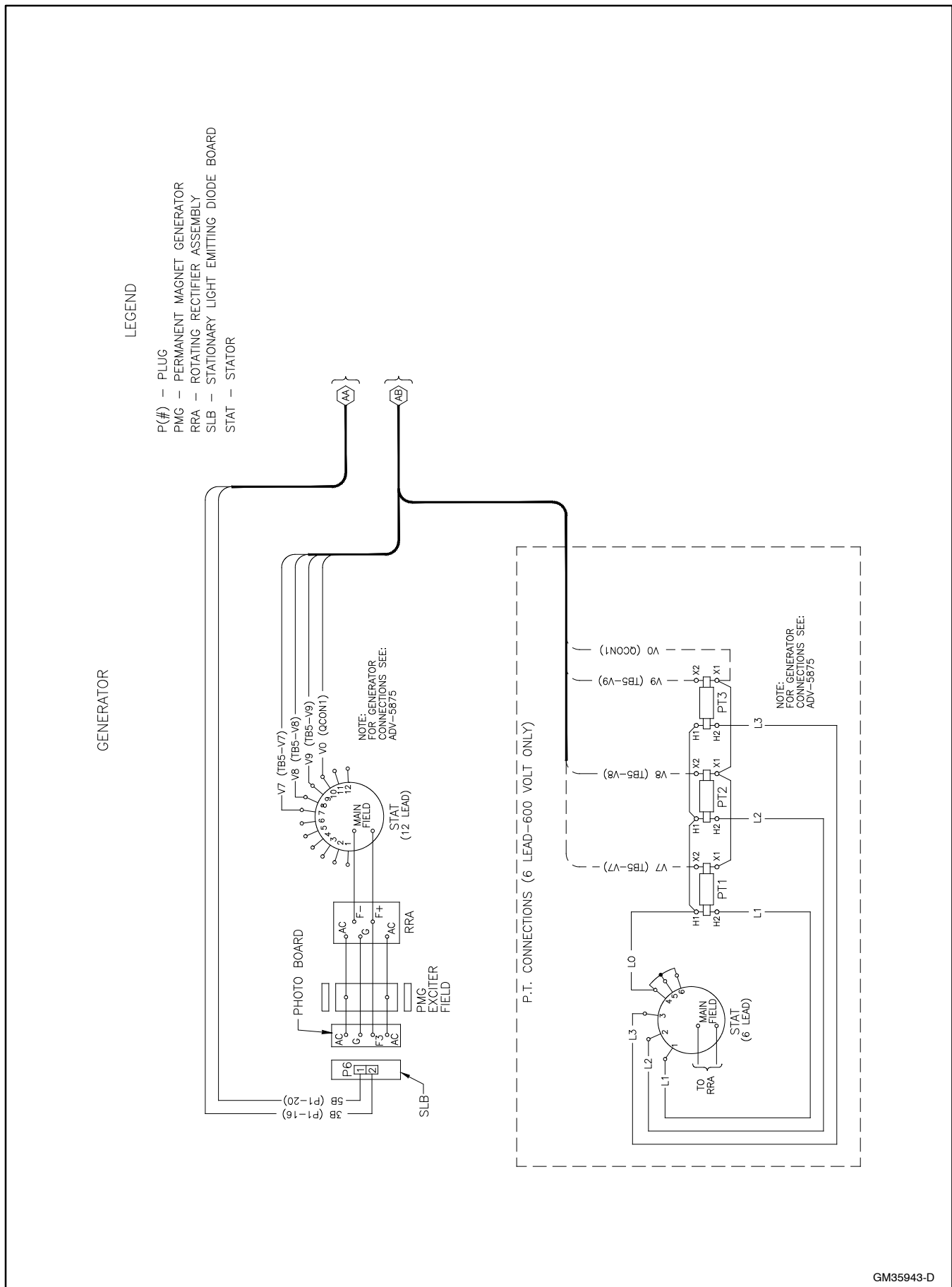


**Figure 5-23** 125/150EOZD(C)J and 100/125EFOZD(C)J Wiring Diagram, Decision-Maker® 3500, Sheet 3 of 3



Section 5 Wiring Diagrams 101





**Figure 5-26** DWG. GM35943, Wiring Diagram Drawing



104 Section 5 Wiring Diagrams



## Section 6 Voltage Reconnection

### 6.1 Introduction

Use the following voltage reconnection schematic to change the voltage of 12-lead generator sets. Frequency changes require voltage regulator *and* governor adjustments. Refer to the respective spec sheet to determine if frequency is fixed or field-convertible. If frequency is adjustable, refer to the engine service manual and/or governor literature for conversion information.

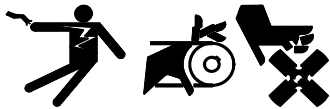
Refer to the following connection schematics. Follow the safety precautions at the front of this manual and in the procedure text and observe National Electrical Code (NEC) guidelines.

#### NOTICE

**Voltage reconnection.** Affix a notice to the generator set after reconnecting the set to a voltage different from the voltage on the nameplate. Order voltage reconnection decal 246242 from an authorized service distributor/dealer.

**Note: Equipment damage.** Verify that the voltage ratings of the transfer switch, line circuit breakers, and other accessories match the selected line voltage.

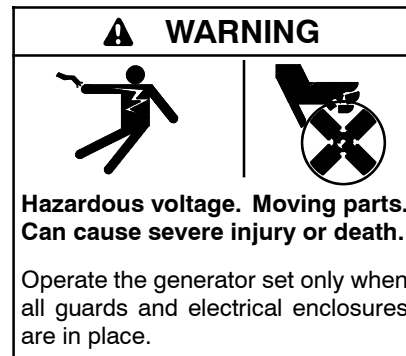
#### ⚠ WARNING



**Accidental starting.**  
**Can cause severe injury or death.**

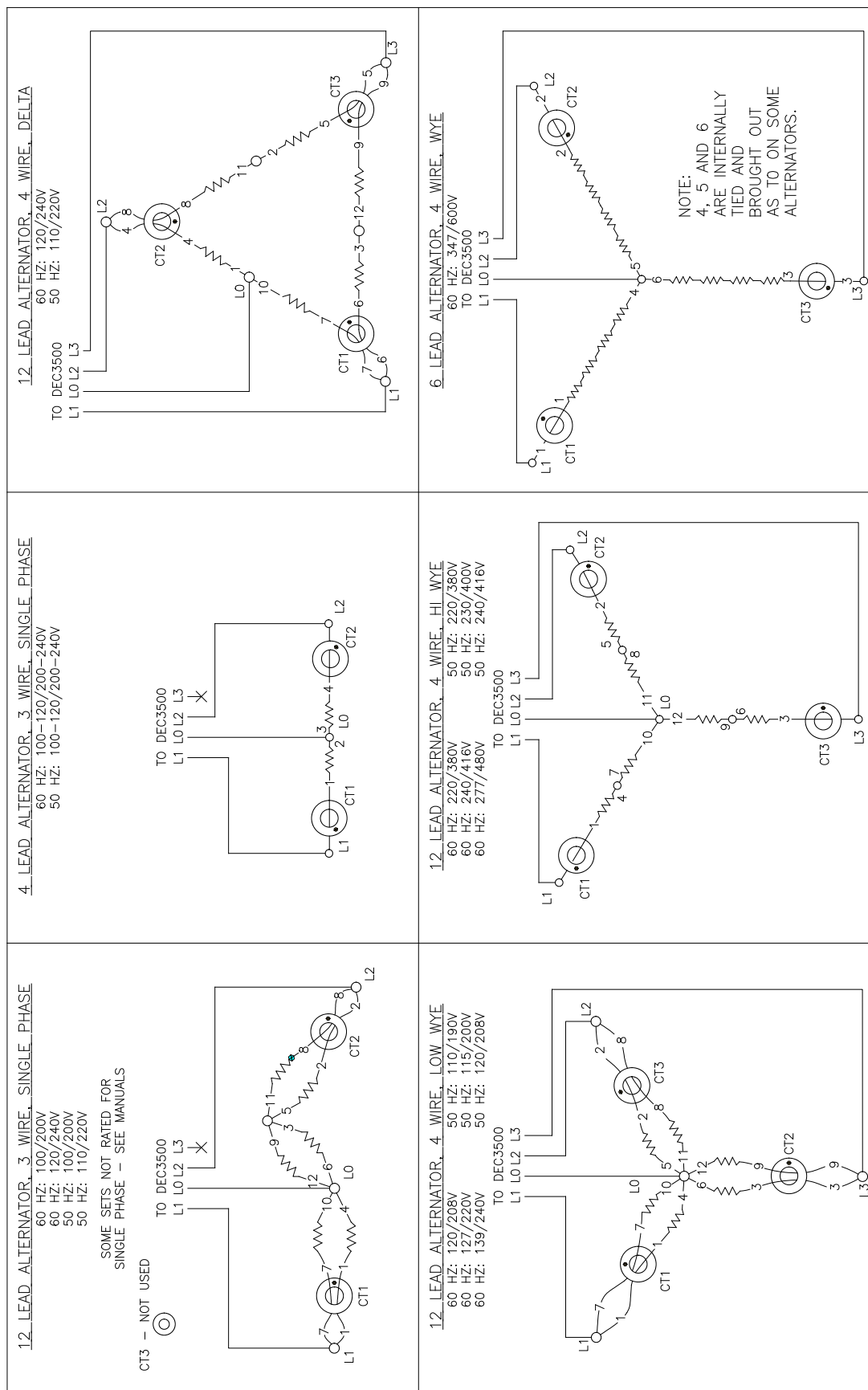
Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

**Disabling the generator set. Accidental starting can cause severe injury or death.** Before working on the generator set or equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.



**Grounding electrical equipment. Hazardous voltage can cause severe injury or death.** Electrocutation is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

**Short circuits. Hazardous voltage/current can cause severe injury or death.** Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.



NOTES:  
 CURRENT TRANSFORMER DOT OR "H1" TOWARD GENERATOR.  
 CURRENT TRANSFORMERS NOT USED ON ALL SETS.

PHASE ROTATION  
 A B C  
 L1 L2 L3

DEC3500

**Figure 6-1** Wiring Diagram, Alternator Reconnections, 12 Lead, Sheet 1 of 1 (ADV-5875F-R)

### 7.1 Accessories

Several accessories help finalize installation, add convenience to operation and service, and establish state and local code compliance.

Accessories vary with each generator set model and controller. Select factory-installed and/or shipped-loose accessories. Obtain the most current accessory information from your local authorized service distributor/dealer.

Accessory kits generally include installation instructions. See the wiring diagrams for electrical connections not shown in this section. See the installation instructions and drawings supplied with the kit for information on kit mounting location.

The instructions provided with the accessory kit supersede these instructions where there are differences. In general, run AC and DC wiring in separate conduit. Use shielded cable for all analog inputs. Observe all applicable national, state, and local electrical codes during accessory installation.

See Section 7.2, Accessory Connections, for terminal identification.

### 7.2 Accessory Connections

The controller contains a circuit board equipped with connectors for use in connecting external optional accessories including alarms, battery chargers, and remote switches. The optional fifteen relay dry contact board provides an additional four digital inputs and two analog inputs.

For specific information on accessory connections, refer to the accessory wiring diagrams in the wiring diagram manual and the instruction sheet accompanying the kit. See Figure 7-4 for controller circuit board connections.

**Circuit Board Connections** (see Figure 7-1). Consult the wiring diagrams in Section 5 for more detail and model-specific information.

- **P1 (35-Pin) Connector** for engine/generator wiring harness.
- **P2 (14-Pin) Connector** for sensor input connections and relay driver output connections.
- **P3 (8-Pin) Connector** for generator set output voltage connection and paralleling bus voltage sensing connections.
- **P4 (Ethernet) RG 45 Connector** connects to a network communication line.

**DEC 3500 Controller Front Panel** (see Figure 7-2).

- **Mini USB Connector** for connection of a PC with SiteTech™ software programming or for firmware updates.

**TB12 Terminal Strip** (see Figure 7-3) for CAN, PGEN, remote emergency stop, and remote start connections. Consult the wiring diagrams in Section 5 for more detail and model-specific information.



| P1 35-Pin Connector, Engine/Generator Wiring Harness |   |   |
|--|---|---|
| Terminal   | Description                                       | Connection  |
| P1-1   | 71  | P23-1 (71)  |
| P1-2   | Open  | -   |
| P1-3   | N   | P1B-31  |
| P1-4   | 3B  | P6-2 (3B)   |
| P1-5   | YEL   | P1B-34 (YEL)  |
| P1-6   | GRN   | P1B-33 (GRN)  |
| P1-7   | Open<br>or<br>BLU<br>(40EOZD(C)J/<br>33EFOZD(C)J) | -<br>or<br>P1B-28 (Blue)<br>(40EOZD(C)J/<br>33EFOZD(C)J)  |
| P1-8   | Open<br>or<br>GRN<br>(40EOZD(C)J/<br>33EFOZD(C)J) | -<br>or<br>P1B-29 (Green)<br>(40EOZD(C)J/<br>33EFOZD(C)J) |
| P1-9   | YEL   | TB12-CAN(+)   |
| P1-10  | GRN   | TB12-CAN(-)   |
| P1-11  | BLK   | TB12-COM (-)  |
| P1-12  | RED   | TB12-COM (+)  |
| P1-13  | 70  | P30-3 (70)  |
| P1-14  | 1   | TB12-1 (1)  |
| P1-15  | 3   | TB12-3 (3)  |
| P1-16  | IR  | P26-2 (IR)  |
| P1-17  | I2  | P26-3 (I2)  |
| P1-18  | Open<br>or<br>7<br>(40EOZD(C)J/<br>33EFOZD(C)J)   | -<br>or<br>P1B-13 (7)<br>(40EOZD(C)J/<br>33EFOZD(C)J)     |
| P1-19  | 69  | P1B-8 (69)  |
| P1-20  | Open  | -   |
| P1-21  | 37  | P1B-5 (37)  |
| P1-22  | 25  | P1B-2 (25)  |
| P1-23  | YEL   | TB12-PGEN (-) (YEL)                                       |
| P1-24  | P1  | P1B-4 (P1)  |
| P1-25  | 31A   | P1B-25 (31A)  |
| P1-26  | 1A  | TB12-1A (1A)  |
| P1-27  | 30  | TB12-AUX (30)   |
| P1-28  | I3  | P26-5 (I3)  |
| P1-29  | I1  | P26-1 (I1)  |
| P1-30  | Open<br>or<br>5<br>(40EOZD(C)J/<br>33EFOZD(C)J)   | -<br>or<br>P1B-17 (5)<br>(40EOZD(C)J/<br>33EFOZD(C)J)     |
| P1-31  | BGA   | P1B-27 (BGA)  |
| P1-32  | Open  | -   |
| P1-33  | 64  | P1B-1 (64)  |
| P1-34  | 31  | P1B-3 (31)  |
| P1-35  | ORG   | TB12-PGEN (+) (ORG)                                       |

| P2 14-Pin Connector, Analog/Digital Input and Relay Driver Output Connections      |                                      |  |
|--|--------------------------------------|--|
| Terminal   | Description                          | Connection                                     |
| P2-1   | 87                                   | P1B-20   |
| P2-2   | BSP<br>Circuit Breaker<br>Status (+) | TB13-BSP                                       |
| P2-3   | VBP<br>Voltage Bias (+)              | TB13-VBP                                       |
| P2-4   | SBP<br>Speed Bias (+)                | TB13-SBP                                       |
| P2-5   | CBO<br>Circuit Breaker<br>Open       | TB13-CBO                                       |
| P2-6   | BSN<br>Circuit Breaker<br>Status (-) | TB13-BSN                                       |
| P2-7   | VBN<br>Voltage Bias (-)              | TB13-VBN                                       |
| P2-8   | SBN<br>Speed Bias (-)                | TB13-SBN                                       |
| P2-9   | CBC<br>Circuit Breaker<br>Close      | TB13-CBC                                       |
| P2-10  | 5P                                   | P1B-7  |
| P2-11  | Open                                 | -  |
| P2-12  | 7                                    | P1B-18   |
| P2-13  | RD3<br>Relay Driver 3                | TB13-12  |
| P2-14  | RD4<br>Relay Driver 4                | TB13-13  |
| P3 8-Pin Connector, Output Voltage and Paralleling Bus Voltage Sensing Connections |                                      |  |
| Terminal   | Description                          | Connection                                     |
| P3-1   | A                                    | INSA* (without C/B)<br>CBRK*-Line A (with C/B) |
| P3-2   | B                                    | INSB* (without C/B)<br>CBRK*-Line B (with C/B) |
| P3-3   | Open                                 | -  |
| P3-4   | L3 Bus Voltage<br>Sense              | TB13-L3  |
| P3-5   | C                                    | INSC* (without C/B)<br>CBRK*-Line C (with C/B) |
| P3-6   | NEU                                  | INSLO*   |
| P3-7   | L1 Bus Voltage<br>Sense              | TB13-L1  |
| P3-8   | L2 Bus Voltage<br>Sense              | TB13-L2  |

| P4 Connector, RJ45 Ethernet |                        |
|-----------------------------|------------------------|
| Open                        | Network communications |

\* INSA, INSB, INSC, INSLO = Insulated Standoff  
CBRK = Circuit Breaker

**Figure 7-4** Controller Connections

## Notes

# Appendix A Abbreviations

The following list contains abbreviations that may appear in this publication.

|           |  |                             |  |                      |  |
|-----------|--|-----------------------------|--|----------------------|--|
| A, amp    | ampere   | cfm                         | cubic feet per minute  | exh.                 | exhaust  |
| ABDC      | after bottom dead center   | CG                          | center of gravity  | ext.                 | external   |
| AC        | alternating current  | CID                         | cubic inch displacement  | F                    | Fahrenheit, female                                   |
| A/D       | analog to digital  | CL                          | centerline   | FHM                  | flat head machine (screw)                            |
| ADC       | advanced digital control;<br>analog to digital converter                                   | cm                          | centimeter   | fl. oz.              | fluid ounce  |
| adj.      | adjust, adjustment   | CMOS                        | complementary metal oxide<br>substrate (semiconductor)                               | flex.                | flexible   |
| ADV       | advertising dimensional<br>drawing   | com                         | communications (port)  | freq.                | frequency  |
| Ah        | amp-hour   | coml                        | commercial   | FS                   | full scale   |
| AHWT      | anticipatory high water<br>temperature   | Coml/Rec                    | Commercial/Recreational  | ft.                  | foot, feet   |
| AISI      | American Iron and Steel<br>Institute   | conn.                       | connection   | ft. lb.              | foot pounds (torque)                                 |
| ALOP      | anticipatory low oil pressure  | cont.                       | continued  | ft./min.             | feet per minute                                      |
| alt.      | alternator   | CPVC                        | chlorinated polyvinyl chloride   | ftp                  | file transfer protocol                               |
| Al        | aluminum   | crit.                       | critical   | g                    | gram   |
| ANSI      | American National Standards<br>Institute (formerly American<br>Standards Association, ASA) | CSA                         | Canadian Standards<br>Association  | ga.                  | gauge (meters, wire size)                            |
| AO        | anticipatory only  | CT                          | current transformer  | gal.                 | gallon   |
| APDC      | Air Pollution Control District   | Cu                          | copper   | gen.                 | generator  |
| API       | American Petroleum Institute   | cUL                         | Canadian Underwriter's<br>Laboratories   | genset               | generator set  |
| approx.   | approximate, approximately   | CUL                         | Canadian Underwriter's<br>Laboratories   | GFI                  | ground fault interrupter                             |
| APU       | Auxiliary Power Unit   | cu. in.                     | cubic inch   | GND, ⊕               | ground   |
| AQMD      | Air Quality Management District  | cw.                         | clockwise  | gov.                 | governor   |
| AR        | as required, as requested  | CWC                         | city water-cooled  | gph                  | gallons per hour                                     |
| AS        | as supplied, as stated, as<br>suggested  | cyl.                        | cylinder   | gpm                  | gallons per minute                                   |
| ASE       | American Society of Engineers  | D/A                         | digital to analog  | gr.                  | grade, gross   |
| ASME      | American Society of<br>Mechanical Engineers  | DAC                         | digital to analog converter  | GRD                  | equipment ground                                     |
| assy.     | assembly   | dB                          | decibel  | gr. wt.              | gross weight   |
| ASTM      | American Society for Testing<br>Materials  | dB(A)                       | decibel (A weighted)   | H x W x D            | height by width by depth                             |
| ATDC      | after top dead center  | DC                          | direct current   | HC                   | hex cap  |
| ATS       | automatic transfer switch  | DCR                         | direct current resistance  | HCHT                 | high cylinder head temperature                       |
| auto.     | automatic  | deg., °                     | degree   | HD                   | heavy duty   |
| aux.      | auxiliary  | dept.                       | department   | HET                  | high exhaust temp., high<br>engine temp.             |
| avg.      | average  | dia.                        | diameter   | hex                  | hexagon  |
| AVR       | automatic voltage regulator  | DI/EO                       | dual inlet/end outlet  | Hg                   | mercury (element)                                    |
| AWG       | American Wire Gauge  | DIN                         | Deutsches Institut für Normung<br>e. V. (also Deutsche Industrie<br>Normenausschuss) | HH                   | hex head   |
| AWM       | appliance wiring material  | DIP                         | dual inline package  | HHC                  | hex head cap   |
| bat.      | battery  | DPDT                        | double-pole, double-throw  | HP                   | horsepower   |
| BBDC      | before bottom dead center  | DPST                        | double-pole, single-throw  | hr.                  | hour   |
| BC        | battery charger, battery<br>charging   | DS                          | disconnect switch  | HS                   | heat shrink  |
| BCA       | battery charging alternator  | DVR                         | digital voltage regulator  | hsg.                 | housing  |
| BCI       | Battery Council International  | E <sup>2</sup> PROM, EEPROM | electrically-erasable<br>programmable read-only<br>memory                            | HVAC                 | heating, ventilation, and air<br>conditioning        |
| BDC       | before dead center   | E, emer.                    | emergency (power source)   | HWT                  | high water temperature                               |
| BHP       | brake horsepower   | ECM                         | electronic control module,<br>engine control module                                  | Hz                   | hertz (cycles per second)                            |
| blk.      | black (paint color), block<br>(engine)   | EDI                         | electronic data interchange  | IBC                  | International Building Code                          |
| blk. htr. | block heater   | EFR                         | emergency frequency relay  | IC                   | integrated circuit                                   |
| BMEP      | brake mean effective pressure  | e.g.                        | for example ( <i>exempli gratia</i> )  | ID                   | inside diameter, identification                      |
| bps       | bits per second  | EG                          | electronic governor  | IEC                  | International Electrotechnical<br>Commission         |
| br.       | brass  | EGSA                        | Electrical Generating Systems<br>Association   | IEEE                 | Institute of Electrical and<br>Electronics Engineers |
| BTDC      | before top dead center   | EIA                         | Electronic Industries<br>Association   | IMS                  | improved motor starting                              |
| Btu       | British thermal unit   | EI/EO                       | end inlet/end outlet   | in.                  | inch   |
| Btu/min.  | British thermal units per minute   | EMI                         | electromagnetic interference   | in. H <sub>2</sub> O | inches of water                                      |
| C         | Celsius, centigrade  | emiss.                      | emission   | in. Hg               | inches of mercury                                    |
| cal.      | calorie  | eng.                        | engine   | in. lb.              | inch pounds  |
| CAN       | controller area network  | EPA                         | Environmental Protection<br>Agency   | Inc.                 | incorporated   |
| CARB      | California Air Resources Board   | EPS                         | emergency power system   | ind.                 | industrial   |
| CAT5      | Category 5 (network cable)   | ER                          | emergency relay  | int.                 | internal   |
| CB        | circuit breaker  | ES                          | engineering special,<br>engineered special   | int./ext.            | internal/external                                    |
| CC        | crank cycle  | ESD                         | electrostatic discharge  | I/O                  | input/output   |
| cc        | cubic centimeter   | est.                        | estimated  | IP                   | internet protocol                                    |
| CCA       | cold cranking amps   | E-Stop                      | emergency stop   | ISO                  | International Organization for<br>Standardization    |
| ccw.      | counterclockwise   | etc.                        | et cetera (and so forth)   | J                    | joule  |
| CEC       | Canadian Electrical Code   |                             |  | JIS                  | Japanese Industry Standard                           |
| cert.     | certificate, certification, certified  |                             |  | k                    | kilo (1000)  |
| cfh       | cubic feet per hour  |                             |  | K                    | kelvin   |
|           |  |                             |  | kA                   | kiloampere   |
|           |  |                             |  | KB                   | kilobyte (2 <sup>10</sup> bytes)                     |
|           |  |                             |  | KBus                 | Kohler communication protocol                        |
|           |  |                             |  | kg                   | kilogram   |

|                      |  |           |   |         |   |
|----------------------|--|-----------|---|---------|---|
| kg/cm <sup>2</sup>   | kilograms per square centimeter                      | NBS       | National Bureau of Standards                        | RTU     | remote terminal unit  |
| kgm                  | kilogram-meter                                       | NC        | normally closed                                     | RTV     | room temperature vulcanization  |
| kg/m <sup>3</sup>    | kilograms per cubic meter                            | NEC       | National Electrical Code                            | RW      | read/write  |
| kHz                  | kilohertz  | NEMA      | National Electrical Manufacturers Association       | SAE     | Society of Automotive Engineers                                       |
| kJ                   | kilojoule  | NFPA      | National Fire Protection Association                | scfm    | standard cubic feet per minute  |
| km                   | kilometer  | Nm        | newton meter  | SCR     | silicon controlled rectifier  |
| kOhm, kΩ             | kilo-ohm   | NO        | normally open                                       | s, sec. | second  |
| kPa                  | kilopascal   | no., nos. | number, numbers                                     | SI      | <i>Système international d'unités</i> , International System of Units |
| kph                  | kilometers per hour                                  | NPS       | National Pipe, Straight                             | SI/EO   | side in/end out   |
| kV                   | kilovolt   | NPSC      | National Pipe, Straight-coupling                    | sil.    | silencer  |
| kVA                  | kilovolt ampere                                      | NPT       | National Standard taper pipe thread per general use | SMTP    | simple mail transfer protocol   |
| kVAR                 | kilovolt ampere reactive                             | NPTF      | National Pipe, Taper-Fine                           | SN      | serial number   |
| kW                   | kilowatt   | NR        | not required, normal relay                          | SNMP    | simple network management protocol                                    |
| kWh                  | kilowatt-hour  | ns        | nanosecond  | SPDT    | single-pole, double-throw   |
| kWm                  | kilowatt mechanical                                  | OC        | overcrank   | SPST    | single-pole, single-throw   |
| kWth                 | kilowatt-thermal                                     | OD        | outside diameter                                    | spec    | specification   |
| L                    | liter  | OEM       | original equipment manufacturer                     | specs   | specification(s)  |
| LAN                  | local area network                                   | OF        | overfrequency                                       | sq.     | square  |
| L x W x H            | length by width by height                            | opt.      | option, optional                                    | sq. cm  | square centimeter   |
| lb.                  | pound, pounds  | OS        | oversize, overspeed                                 | sq. in. | square inch   |
| lbm/ft <sup>3</sup>  | pounds mass per cubic feet                           | OSHA      | Occupational Safety and Health Administration       | SMS     | short message service   |
| LCB                  | line circuit breaker                                 | OV        | overvoltage   | SS      | stainless steel   |
| LCD                  | liquid crystal display                               | oz.       | ounce   | std.    | standard  |
| LED                  | light emitting diode                                 | p., pp.   | page, pages   | stl.    | steel   |
| Lph                  | liters per hour                                      | PC        | personal computer                                   | tach.   | tachometer  |
| Lpm                  | liters per minute                                    | PCB       | printed circuit board                               | TB      | terminal block  |
| LOP                  | low oil pressure                                     | pF        | picofarad   | TCP     | transmission control protocol   |
| LP                   | liquefied petroleum                                  | PF        | power factor  | TD      | time delay  |
| LPG                  | liquefied petroleum gas                              | ph., ∅    | phase   | TDC     | top dead center   |
| LS                   | left side  | PHC       | Phillips® head Crimptite® (screw)                   | TDEC    | time delay engine cooldown  |
| L <sub>wa</sub>      | sound power level, A weighted                        | PHH       | Phillips® hex head (screw)                          | TDEN    | time delay emergency to normal  |
| LWL                  | low water level                                      | PHM       | pan head machine (screw)                            | TDES    | time delay engine start   |
| LWT                  | low water temperature                                | PLC       | programmable logic control                          | TDNE    | time delay normal to emergency  |
| m                    | meter, milli (1/1000)                                | PMG       | permanent magnet generator                          | TDOE    | time delay off to emergency   |
| M                    | mega (10 <sup>6</sup> when used with SI units), male | pot       | potentiometer, potential                            | TDON    | time delay off to normal  |
| m <sup>3</sup>       | cubic meter  | ppm       | parts per million                                   | temp.   | temperature   |
| m <sup>3</sup> /hr.  | cubic meters per hour                                | PROM      | programmable read-only memory                       | term.   | terminal  |
| m <sup>3</sup> /min. | cubic meters per minute                              | psi       | pounds per square inch                              | THD     | total harmonic distortion   |
| mA                   | milliampere  | psig      | pounds per square inch gauge                        | TIF     | telephone influence factor  |
| man.                 | manual   | pt.       | pint  | tol.    | tolerance   |
| max.                 | maximum  | PTC       | positive temperature coefficient                    | turbo.  | turbocharger  |
| MB                   | megabyte (2 <sup>20</sup> bytes)                     | PTO       | power takeoff                                       | typ.    | typical (same in multiple locations)                                  |
| MCCB                 | molded-case circuit breaker                          | PVC       | polyvinyl chloride                                  | UF      | underfrequency  |
| MCM                  | one thousand circular mils                           | qt.       | quart, quarts                                       | UHF     | ultrahigh frequency   |
| megggar              | megohmmeter  | qty.      | quantity  | UIF     | user interface  |
| MHz                  | megahertz  | R         | replacement (emergency)                             | UL      | Underwriter's Laboratories, Inc.                                      |
| mi.                  | mile   | rad.      | power source  | UNC     | unified coarse thread (was NC)  |
| mil                  | one one-thousandth of an inch                        | RAM       | radiator, radius                                    | UNF     | unified fine thread (was NF)  |
| min.                 | minimum, minute                                      | RDO       | random access memory                                | univ.   | universal   |
| misc.                | miscellaneous  | ref.      | relay driver output                                 | URL     | uniform resource locator (web address)                                |
| MJ                   | megajoule  | rem.      | reference   | US      | undersize, underspeed   |
| mJ                   | millijoule   | Res/Coml  | remote  | UV      | ultraviolet, undervoltage   |
| mm                   | millimeter   | RFI       | Residential/Commercial radio frequency interference | V       | volt  |
| mOhm, mΩ             | milliohm   | RH        | round head  | VAC     | volts alternating current   |
| MOhm, MΩ             | megohm   | RHM       | round head machine (screw)                          | VAR     | voltampere reactive   |
| MOV                  | metal oxide varistor                                 | rly.      | relay   | VDC     | volts direct current  |
| MPa                  | megapascal   | rms       | root mean square                                    | VFD     | vacuum fluorescent display  |
| mpg                  | miles per gallon                                     | rnd.      | round   | VGA     | video graphics adapter  |
| mph                  | miles per hour                                       | RO        | read only   | VHF     | very high frequency   |
| MS                   | military standard                                    | ROM       | read only memory                                    | W       | watt  |
| ms                   | millisecond  | rot.      | rotate, rotating                                    | WCR     | withstand and closing rating  |
| m/sec.               | meters per second                                    | rpm       | revolutions per minute                              | w/      | with  |
| mtg.                 | mounting   | RS        | right side  | WO      | write only  |
| MTU                  | Motoren-und Turbinen-Union                           | RTDs      | Resistance Temperature Detectors                    | w/o     | without   |
| MW                   | megawatt   |           |   | wt.     | weight  |
| mW                   | milliwatt  |           |   | xfrm    | transformer   |
| μF                   | microfarad   |           |   |         |   |
| N, norm.             | normal (power source)                                |           |   |         |   |
| NA                   | not available, not applicable                        |           |   |         |   |
| nat. gas             | natural gas  |           |   |         |   |



## Appendix B Alternator Protection

---

The controller has built-in thermal protection for the alternator. This feature functions similarly to a thermal circuit breaker. When the output current exceeds the nominal rating for a short period of time the condition causes the fault shutdown. The amount of time at which current is over the rating is inversely related to the amount of current above the nominal rating. In other words, the higher the current, the shorter the acceptable time.

The current and time limits are defined by actual test data and are maintained in the personality parameter file. Although the equation for detecting a fault is proprietary, some of the important limits are shown below for informational purposes.

| Rated Current | Time Delay |
|---------------|------------|
| 200%          | 40 seconds |
| 300%          | 10 seconds |
| 425%          | 5 seconds  |
| 950%          | 1 second   |

## Notes

Use the log below to keep a cumulative record of operating hours on your generator set and the dates required services were performed. Enter hours to the nearest quarter hour.

required services were performed. Enter hours to the nearest quarter hour.

[illegible]

## Notes







**TP-6861 10/14b**

© 2013 and 2014 by Kohler Co. All rights reserved.

# **KOHLER®** Power Systems

KOHLER CO. Kohler, Wisconsin 53044  
Phone 920-457-4441, Fax 920-459-1646  
For the nearest sales/service outlet in the  
US and Canada, phone 1-800-544-2444  
KOHLERPower.com

Kohler Power Systems  
Asia Pacific Headquarters  
7 Jurong Pier Road  
Singapore 619159  
Phone (65) 6264-6422, Fax (65) 6264-6455